April 22, 1957 50 Cents

AVIATION WEEK

A McGRAW-HILL PUBLICATION

Missile Pace Rises At Woomera Range

●

Engineer-Pilot Describes IL-14

TWA's Lockheed 1649A Jetstream

engineers agree

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nor systems of controlled
approach—but every day,
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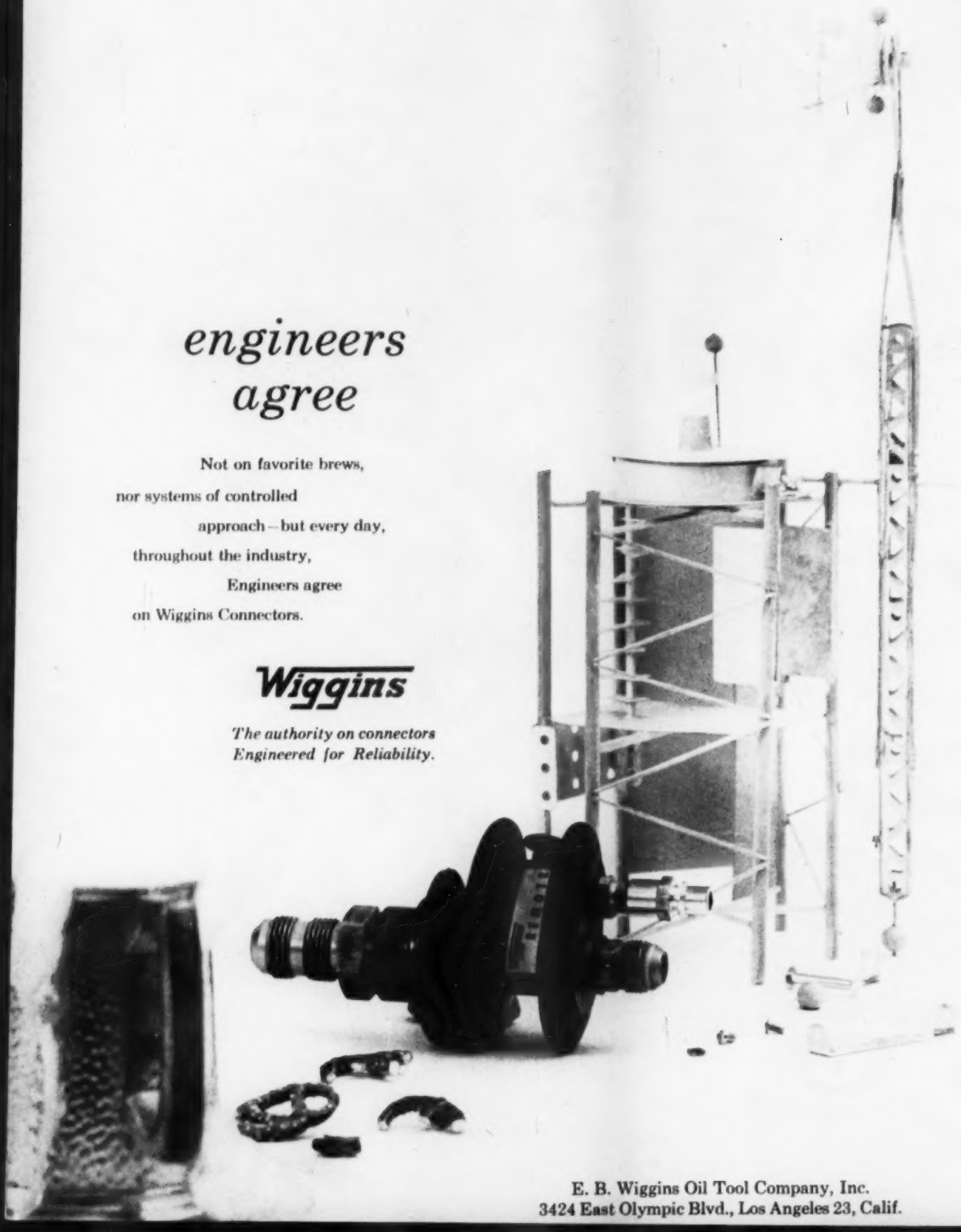

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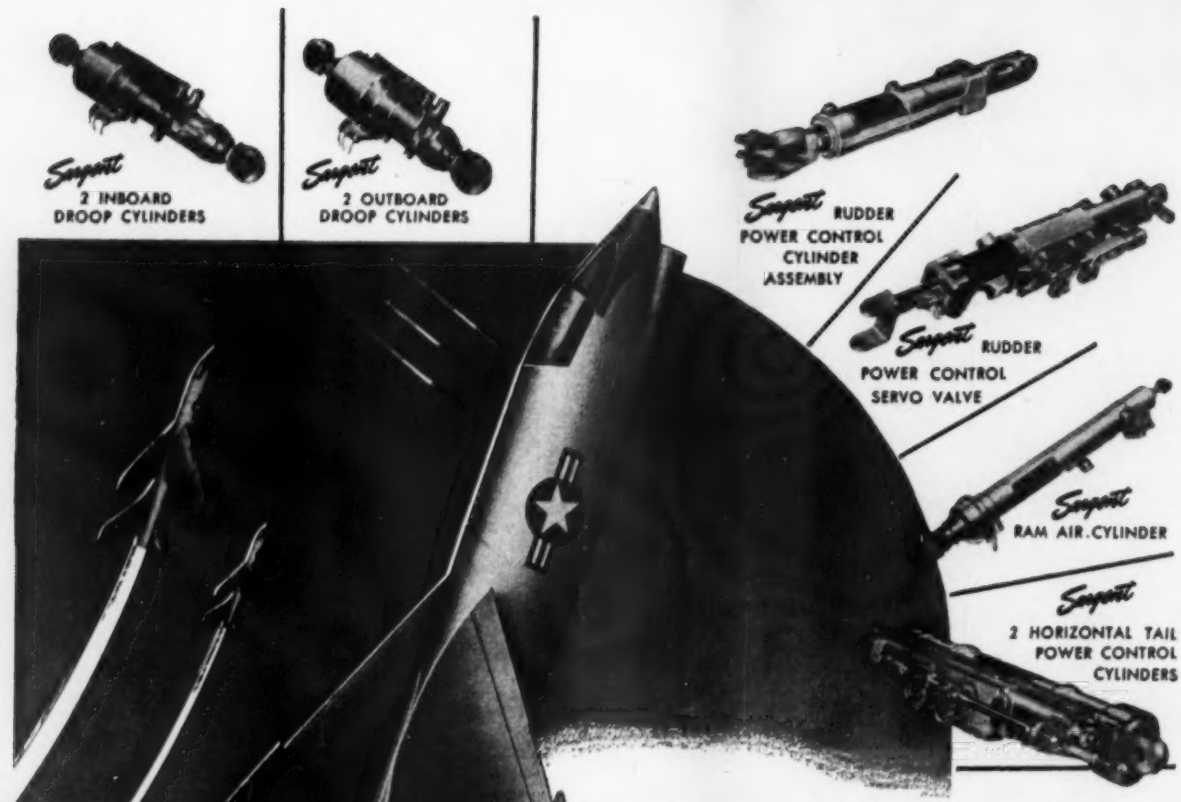

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AVIATION CALENDAR

Apr. 23—Missile Session, New York Section, Association of Electrical Engineers, 7:30 p.m., 33 W. 39th St., New York, N. Y.

Apr. 23-25—International Symposium on Role of Solid State Phenomena in Electrical Circuits, Engineering Societies Bldg., N. Y. C.

Apr. 23-25—Annual Convention, International Airline Navigators Council, Piccadilly Hotel, New York.

Apr. 24-25—National Industrial Research Conference, Conrad Hilton Hotel, Chicago, Ill.

Apr. 29—Third Flight Test Instrumentation Symposium, Statler Hotel, Los Angeles.

Apr. 29-May 2—16th Annual National Conference, Society of Aeronautical Weight Engineers, Broadview Hotel, Wichita.

Apr. 30—Atlantic Rate Commodity Rate Board Meeting, International Air Transport Assn., Torquay, Devonshire, England.

Apr. 30—Electronics Make the Helicopter Fly, annual section meeting, New York Section, American Institute of Electrical Engineers, 33 W. 39th St., New York.

May 1-3—Spring Meeting and Exhibit Society for Experimental Stress Analysis, Hotel Statler, Boston, Mass.

May 2-3—Annual Meeting, Aeronautical Training Society, Mayflower Hotel, Washington, D. C.

May 2-4—Spring Meet, National Intercollegiate Flying Assn., Oklahoma A&M College, Stillwater, Okla.

May 3-5—Seventh Aviation Education Conference, San Jose State College, San Jose, Calif.

May 5-8—1957 Convention American Association of Airport Executives, Shamrock Hilton Hotel, Houston, Tex.

May 6-8—28th Annual Meeting, Aero Medical Assn., Shirley Savoy Hotel, Denver.

May 7-9—Electrical Engineering Aspects of Aircraft and Missiles, American Institute of Electrical Engineers, Biltmore Hotel, Dayton, Ohio.

(*Continued on page 6*)

AVIATION WEEK • APRIL 22, 1957

Vol 66, No. 16

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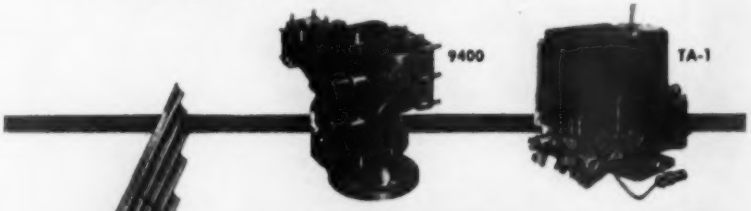

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An informative CECO fact folder is also available on request.

AVIATION CALENDAR

(*Continued from page 5*)

May 7-9—Spring Assembly, Radio Technical Commission for Aeronautics, Ambassador Hotel, Los Angeles, Calif.

May 7-9—East Central & Middle Eastern District Meeting and Air Transportation Conference, American Institute of Electrical Engineers, Dayton-Biltmore Hotel, Dayton, Ohio.

May 8-11—13th Annual National Forum, American Helicopter Society, Sheraton Park Hotel, Washington, D. C.

May 13-15—National Conference on Aeronautical Electronics, Sponsored by the Institute of Radio Engineers, Dayton, Ohio.

May 14—Engine Operation & Maintenance Forum, sponsored by Pratt & Whitney Aircraft Division and distributors, Pacific Airmotive Corp., Cosmopolitan Hotel, Denver, Colo. Other sessions, May 17 at Ambassador Hotel, Burbank, Calif.; May 20 at Hotel Claremont, Oakland, Calif., and May 22, New Washington Hotel, Seattle, Wash.

May 15-17—Jet Age Airport Conference, Air Transport Division, American Society of Civil Engineers, Park-Sheraton Hotel, New York.

May 20—Sixth Annual Aviation Fire Safety Seminar, National Fire Protection Assn., Hotel Statler, Los Angeles, Calif.

May 20-23—Design Engineering Show and Second Annual Design Conference, sponsored by Machine Design Division, American Society of Mechanical Engineers, New York Coliseum, N. Y.

May 23—Guenter Loeser Memorial Lecture, "Progress & Prospects of Radar Meteorology," Dr. David Atlas, Charter Rm., New England Mutual Bldg., Boston.

May 24-June 2—22nd Paris Air Show, Society of French Aircraft Constructors, LeBourget Airport, Paris.

June 1—8th Annual Maintenance and Operations Meeting for Business and Executive Aircraft Owners, sponsored by Reading Aviation Service, Reading Municipal Airport, Pa.

June 1-9—First Annual National Aviation Trade Show, Monmouth (N. J.) Airport.

June 17-20—National Summer Meeting, Institute of the Aeronautical Sciences, Biltmore Hotel, Los Angeles, Calif.

June 23-25—29th Annual Meeting, Aviation Distributors & Manufacturers Assn., The Broadmoor, Colorado Springs, Colo.

June 24—Soviet National Aviation Day, Moscow.

July 12-13—British Lockheed International Aerobatic Competition, the National Air Races (third round) and the King's Cup Air Race, Coventry Civil Aerodrome, Bagington, England.

Aug. 20-23—Western Electronic Show & Convention, Cow Palace, San Francisco.

Sept. 1-6—Sixth International Aeronautical Conference, Royal Aeronautical Society and Institute of the Aeronautical Sciences, Folkstone and London, England.

Sept. 2-8—1957 Flying Display, Society of British Aircraft Constructors, Farnborough, England.

Nov. 7-8—Weapon Systems Management Meeting, Statler-Hilton Hotel, Dallas.

Dec. 17—Wright Brothers Lecture, Department of Commerce Auditorium, Washington, D. C.

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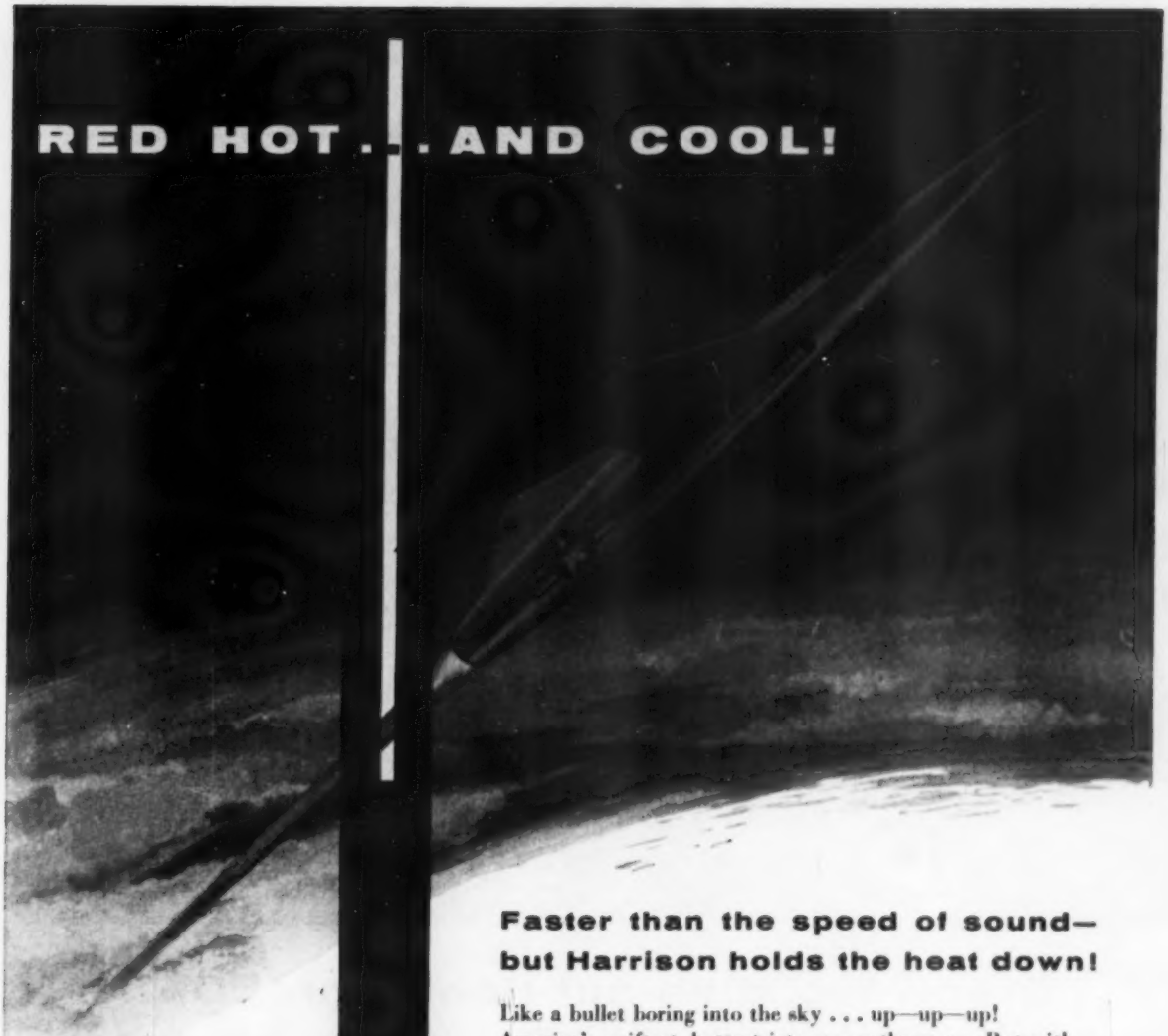

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Like a bullet boring into the sky . . . up—up—up! America's swiftest, hottest jets are on the move. But with Harrison heat exchangers on the job, engines are running cool—temperatures are under control. In fact, you'll find lightweight, heavy-duty Harrison coolers on the job in just about every type of modern aircraft. Design of special cooling equipment for the world's finest, fastest jets is another example of Harrison leadership in temperature control. Long experience and extensive research facilities mean that Harrison is ready and able to meet the cooling demands of the Jet Age. If you have a cooling problem, look to Harrison for the answer.

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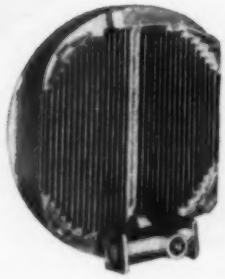

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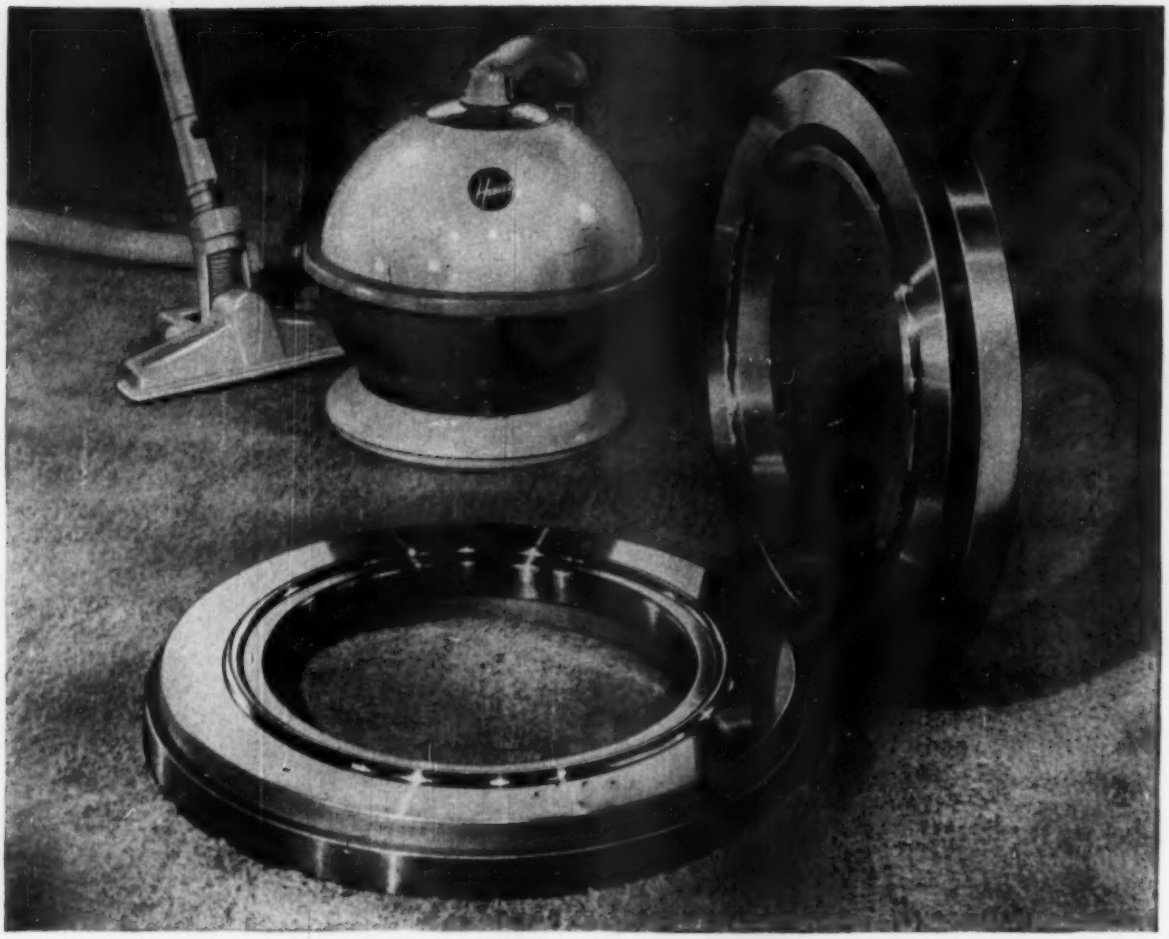

Graph-Mo® dies cut downtime 50% on deep draw for round vacuum cleaner!

ENGINEERS at The Hoover Company had a tough problem in getting that round vacuum cleaner shape in the new Constellation. The two circular dies that form the hemispheres often galled, picking up bits of the steel being formed. This scored the dies, marred the finished parts. Production had to be shut down while the dies were repolished. And extra polishing of the hemispheres ran up costs still more.

After studying the problem, Timken Company metallurgists recommended dies made from Graph-Mo®—a special tool steel developed by the Timken Company. Results were outstanding. The new Graph-Mo dies cut downtime 50%. The combination of free graphite particles and diamond hard carbides in its structure make it outwear other tool steels 3 to 1. Production rolled smoothly and refinishing time was cut.

Graph-Mo machines 30% easier than conventional tool steels. And its uniform response to heat treatment eliminates distortion—saves time and money in lots of tough jobs.

Graph-Mo is one of four graphitic tool steels developed by the Timken Company. If you would like more information about their uses in dies, punches, gages and machine parts, send for the new Timken Graphitic Steel Book. The Timken Roller Bearing Company, Steel and Tube Division, Canton 6, Ohio. Cable address: "TIMROSCO".

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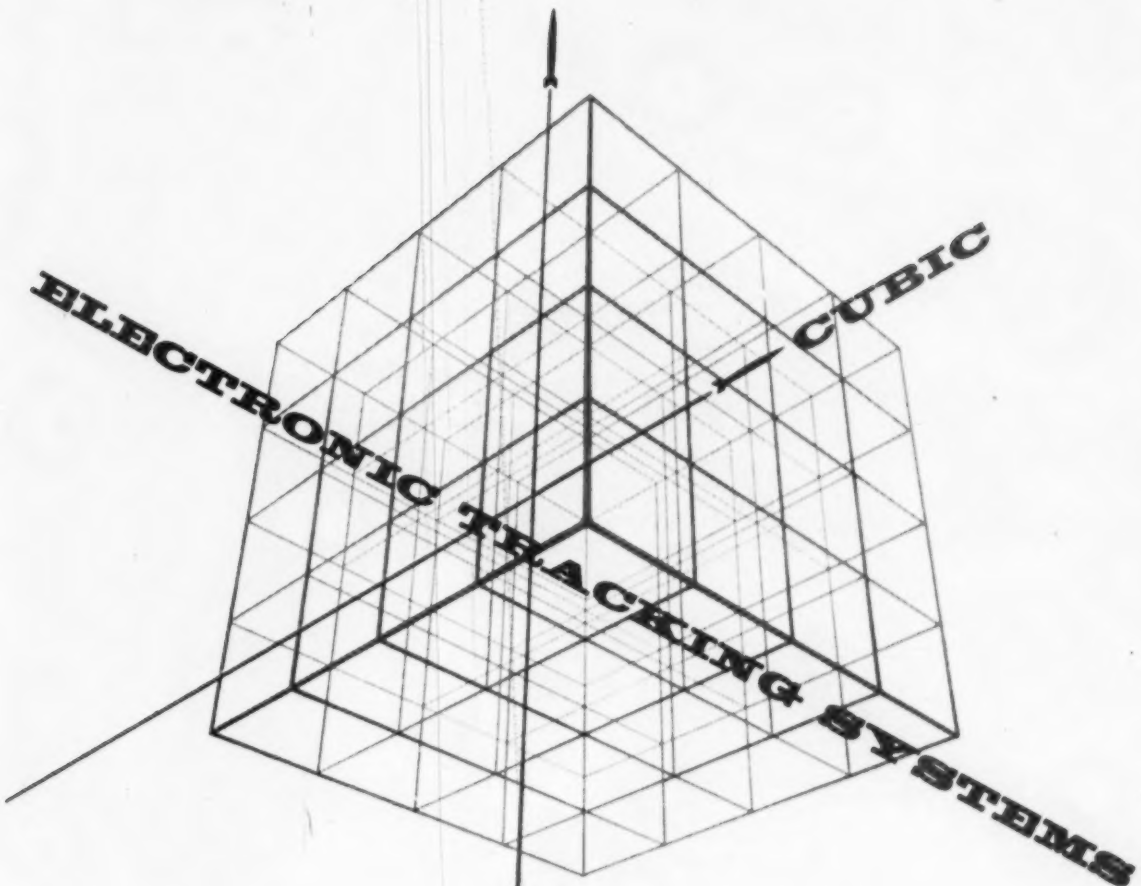

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acquisition: automatic and omnidirectional

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The use of PLEXIGLAS acrylic plastic in aircraft is by no means confined to cockpit enclosures and windows on the country's fighters, bombers, helicopters and commercial transports. Manufacturers of planes for business and pleasure flying, like the makers of the Cessna 310 shown above, also use PLEXIGLAS—to give their customers unrestricted visibility and good service commensurate with the efficiency and comfort that are built into today's small aircraft.

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Johns-Manville structural insulations offer you unparalleled design flexibility

Proof of this design flexibility can be seen in the intricately designed structural insulations Johns-Manville is now producing for the aviation industry.

Precision formed through recently developed methods, Johns-Manville structural insulations meet the exacting design specifications of aircraft manufacturers. They provide the closer temperature control needed for supersonic performance. And—equally important—they are integral structural parts that resist vibration and corrosion to keep maintenance and replacement at a minimum.

J-M aircraft and missile insulations are made of high-heat resistant alloys enclosing Thermoflex® refractory fiber felt. The finished part is light in weight, yet possesses unusual structural strength and rigidity.

So whether you're in the blueprint stage or in prototype testing, whenever and wherever you need HEAT control—call in J-M. Our insulation specialists will give you the design help you need . . . the very latest information on insulation methods employing stainless steel, titanium and other light-weight, heat-resistant alloys.

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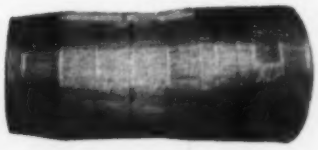

Insulated Engine Shroud

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TDI MINIATURE TELEMETRIC RECEIVING SYSTEMS

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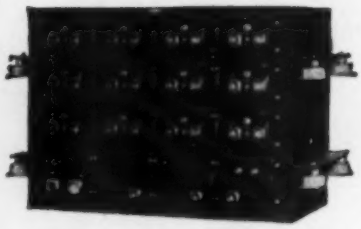
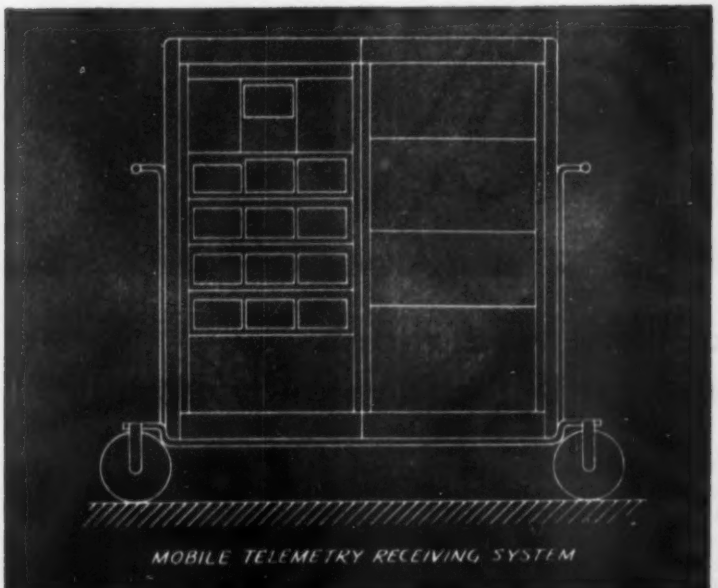
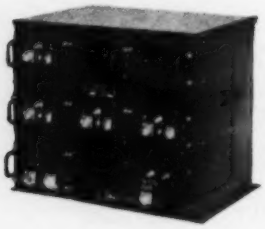
Design-wise, these systems achieve substantial reductions in weight, size and power consumption—yet a high degree of accuracy, exceptional stability and simplicity of operation are maintained.



TDI 12-Channel Receiver. Modular construction permits wide flexibility of arrangement and actual form factor of receiving equipment. Packages or combinations in any number from one to eighteen units can be arranged in various mounting styles.



MOBILE TELEMETRY RECEIVING SYSTEM

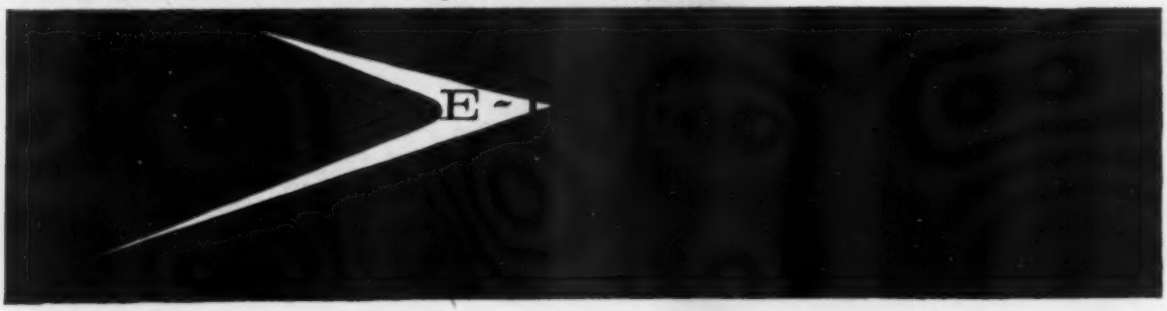


TDI Type 2701A 4-Channel Receiver. Use as flexibly as 12-channel unit—split up in combinations to suit your particular receiving requirements. Ideal for flight line checkout.

◀ Telemetering on wheels! New portable test cart enables users to perform wide variety of telemetering functions in previously inaccessible locations, with greater efficiency and accuracy than ever before.

Technical bulletins on miniature receiving systems and other TDI products available on request.

TDI's newest office is now located at 305 Washington Avenue SE, Albuquerque, New Mexico



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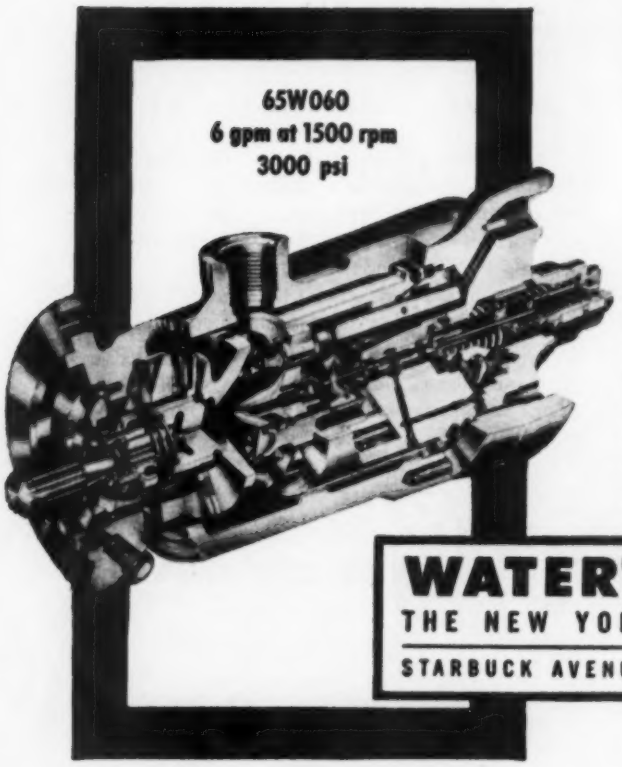

STRATOPOWER 65W 6 and 10 gpm hydraulic pumps have all these features and more –

- Better power to weight ratios.
- Higher top speeds than any other 10 gpm variable delivery pump on the market.
- Lower system pressurization requirements.
- Better delivery schedules.

Whether your problem is weight, speed or delivery, you'll be better off with a STRATOPOWER 65W pump. For specific application or installation data, telephone or write STRATOPOWER Sales Engineering.

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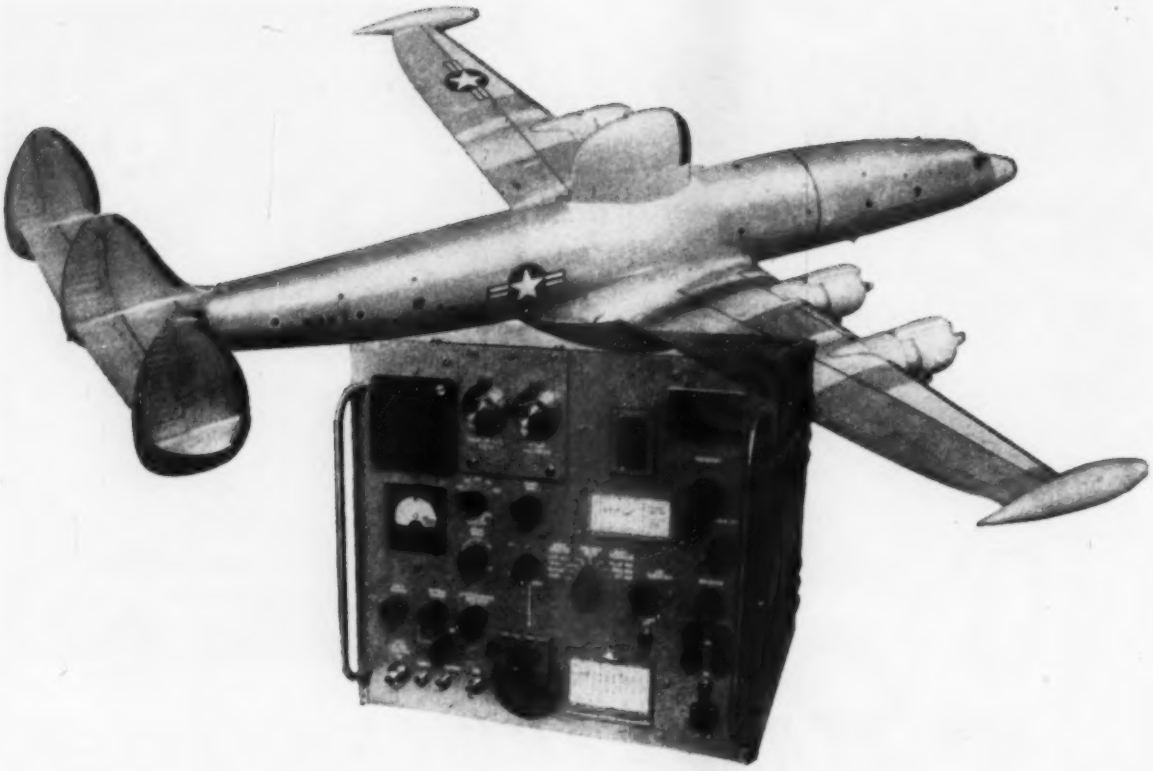

Sperry radar test set rides early warning picket ships

AN/UPM-44B unit checks S-band radar in flight

Checking the performance of search radar aboard Navy WV-2 and Air Force RC-121D radar planes is the job of the Sperry AN/UPM-44B combination test set. While these Lockheed Super Constellations patrol both coasts 24 hours a day, their radars are constantly monitored by AN/UPM-44B test equipment to assure peak efficiency at all times.

Developed by Sperry in cooperation with the Navy's Bureau of Aeronautics to meet all requirements of MIL-T-945A, this new S-band test set combines in a single unit the multiple functions of a frequency meter, power meter, signal generator, spectrum analyzer and synchroscope.

Compact and portable, the AN/UPM-44B provides direct reading of peak or average transmitted power and frequency. It instantly detects any deterioration in performance, and pinpoints the source of trouble for crewmen to take corrective action. Sensitivity, stability and bandwidth measurements are made with pulse or frequency modulated signals produced by the test set. A gating circuit permits spectrum analysis of any selected pulse from a multi-pulse system.

Write our Microwave Electronics Division for additional information covering test sets in the frequency range of 400 mc through 40,000 mc.

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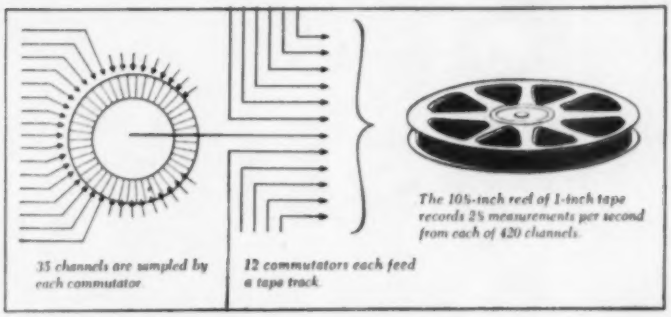
MAGNETIC TAPE APPLICATIONS BY AMPEX

2

How to record 420 channels of simultaneous data

Boeing Airplane Company's flight tests demonstrate an easy way

Have you ever seen an oscillograph record that was eight and a half feet wide? At fifty channels per foot this is what it would take . . . which shows the decided advantages in the way the Boeing Airplane Company solves the problem. They put 420 channels of data onto a one-inch magnetic tape. Two hours of flight test can be recorded on one 10½-inch reel.


35 channels are sampled by each commutator.
12 commutators each feed a tape track.
The 10½-inch reel of 1-inch tape records 2½ measurements per second from each of 420 channels.

In a published article, Mr. Arthur T. Snyder of Boeing describes their system as a low level, low-speed, pulse-width-modulation technique. It time-multiplexes 35 channels of data onto each of 12 tracks (of 14) on an Ampex 814 Airborne Magnetic Recorder; ($35 \times 12 = 420$). The system inputs are variable resistances, thermocouples, strain-gage bridges and other bridge-type transducers. Each is fed to a segment on one of twelve rotating commutators that sample every channel 2½ times per second. The Ampex 814 recorder running at 3¾ in/sec. records over 8-million measurements in two hours.

This recording system used by Boeing is limited *by choice* to data that changes at a slow rate. This is by no means a fixed limitation. Certain Ampex recorders (Series 800, FR-100 and FR-1100) have interchangeable amplifiers. Each track can thus be used with any one of three types of recording according to frequency requirements:

With PWM recording (like the Boeing example) as many as 88 channels of low-frequency data can be put onto one track.

With direct recording up to 18 channels of RDB subcarrier data of varying frequency requirements can go onto one track – or very high-frequency data uses one track per channel.

With FM carrier recording one channel of data occupies one track and provides high instantaneous amplitude accuracy. FM is particularly suitable for shock and vibration records.

When a recording containing a large number of channels of data is reproduced, another of magnetic tape's advantages becomes apparent. The data can be reproduced in electrical form. Consequently it is a relatively simple matter to unscramble the channels by automatic or semi-automatic means. Any combination of channels can be scanned, correlated and fed to computing devices. These fortunate faculties of magnetic tape help reduce the handling of vast amounts of data down to a task of wieldy size. For example in the Boeing flight tests already mentioned, all data is published within two or three days after the test instead of from several weeks to several months later as by previous methods.

Boeing KC-135 tanker in flight.

If you have a specific problem involving large amounts of data or unusual combinations, Ampex's application engineers will be pleased to furnish further information. More of the capabilities of magnetic tape will be discussed in this continuing series of bulletins. Would you like to have copies mailed direct? If so, write Dept. UU-4.

AMPEX CORPORATION

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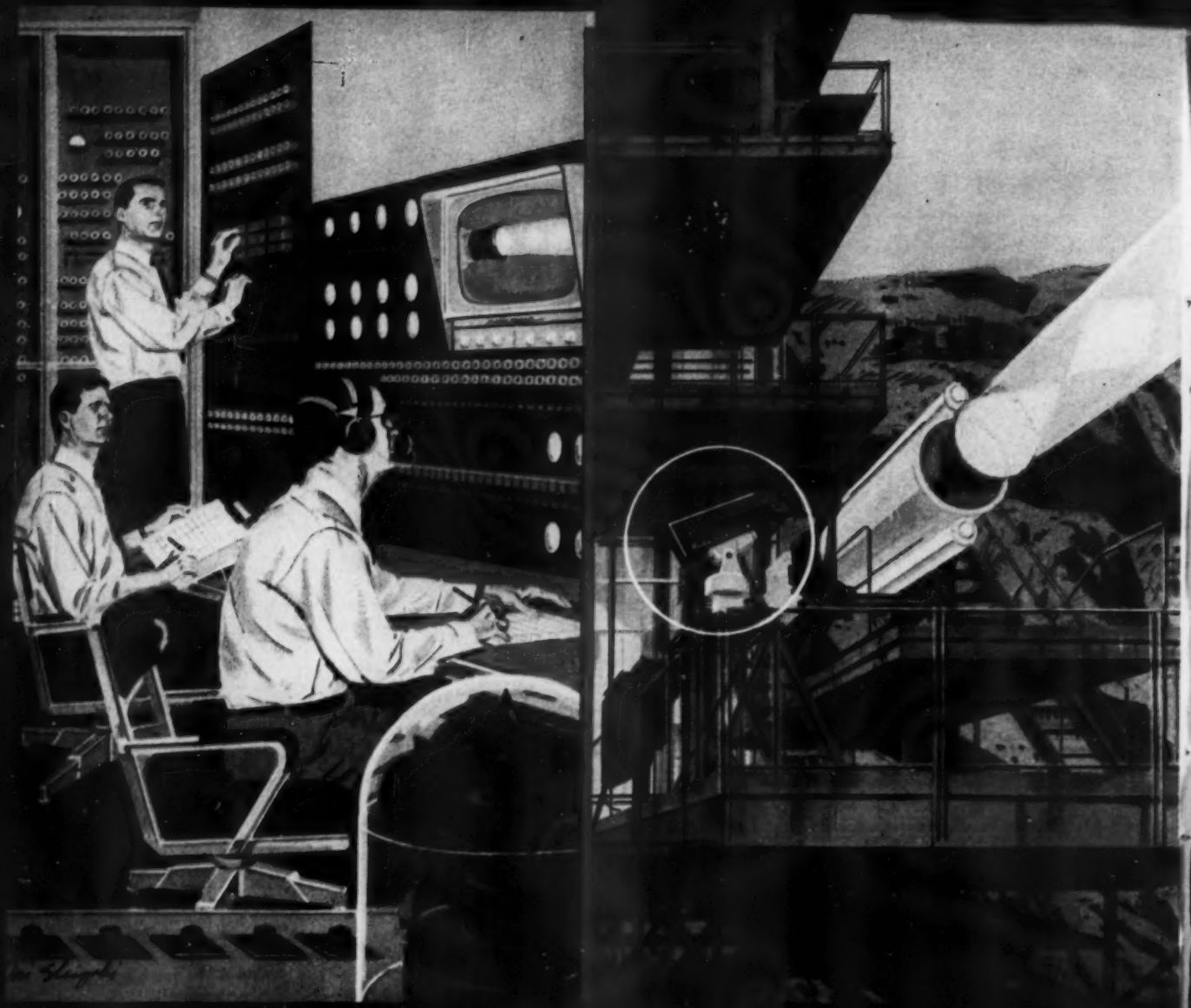

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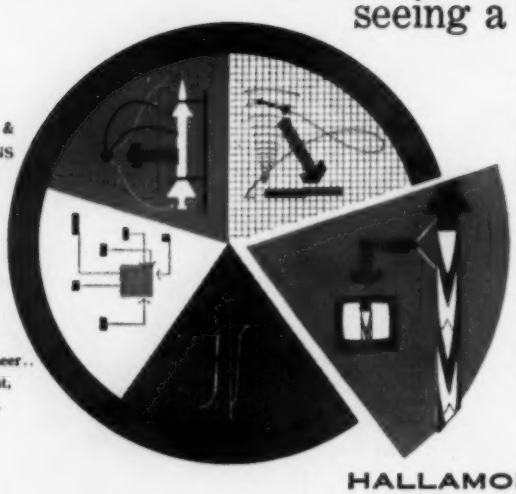

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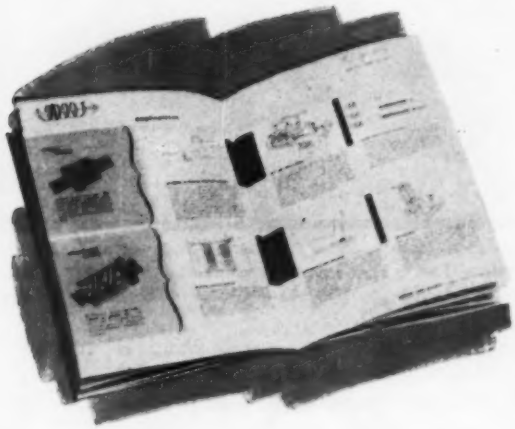

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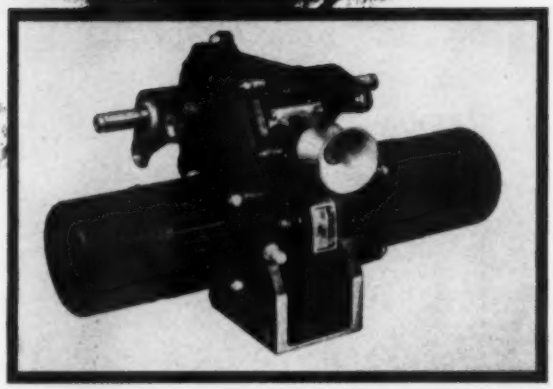

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WESTERN GEAR

APRIL 22, 1957

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COVER: First in-flight photo of Trans World Airline's initial Lockheed 1649A "Jetstream" scheduled for delivery to the airline this week. It will go into airline service July 1. Wing of Super Constellation has been lengthened to 150 ft. in 1649A and propeller diameter is increased to 16 ft. However, tip speed is lower to provide less cabin noise. Nacelles also have been moved outboard from fuselage.

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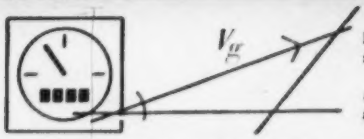

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EDITORIAL

Nuclear Storm Clouds Gather

International events of the past few weeks have seen a pronounced drift toward an eventual showdown between the U.S. and the Soviet Union in the diplomatic maneuvering of nuclear sabre rattling. Both of these nations now possess the capability of large scale nuclear attack to bolster their claims of massive retaliatory force to be applied against any breaker of the uneasy peace that now grips the world. So it is small wonder that allies in both camps and neutrals are becoming increasingly uneasy over this situation.

Perhaps the most important development is the virtual abdication of Britain as a prime military power in the nuclear era. Defense Minister Duncan Sandys has made it clear that Britain is abandoning the primary responsibility for its own defense and placing paramount reliance upon the nuclear warfare capability of the U.S.

This is a bitter pill for proud Britons to swallow. But it is a decision dictated by considerations of purse rather than pride. The sad truth is that Britain can no longer afford the costly investments required for research and development of modern weapon systems required by the supersonic nuclear era. Britain was already lagging badly in this development race before its government acted to relieve itself of the costly nuclear airpower effort.

In effect, Britain is gambling that there will be no major war for another three to five years. For it will be at least this long before the 1,500-mile range guided missiles that it hopes to get from the U.S. will be produced and delivered abroad in sufficient quantity to constitute a genuine retaliatory threat to potential enemies within this range on the European continent. The Douglas Thor missile being developed under USAF sponsorship is still in the early experimental development stage as is its possible alternate, the Army's Jupiter developed at Redstone Arsenal.

This is the second time since the end of World War II that the British have taken a calculated risk on their aerial weapons development program to save a large slice of money. At the end of World War II, British weapons policy was predicated on the gamble that there would be no major war again for at least 10 years. The airpower development program was aimed at skipping a generation of new weapons and jumping directly to the high subsonic fighters and bombers that were scheduled to be in service by 1955. In the meantime, the Royal Air Force was forced to make do with the relatively low speed, straight winged Vampire and Meteor jet fighters that were developed during the closing phase of World War II.

Outbreak of the Korean war in 1950 proved the British planners had made a bad guess. The Royal Air Force had no jet fighters capable of matching the sweptwing Russian MiG-15 that appeared over Korea late in 1950. The burden of air defense of the United Nations coalition fell upon the USAF F-86 Sabre jet, where it lay heavily for the next five years. Only those fighter pilots and war correspondents who were at Kimpo and Suwon airdromes during the fall and winter of 1950-51 know the full story of how badly the British Meteor jets were outclassed when they attempted battle with the MiG-15s. Nor were the new aerial weapons planned for 1955 ready at their appointed hour.

To back up the Sabres' performance in MiG alley, the massive retaliatory capability of the B-36 and B-47 atomic bomber fleet was the sole resource available to the United Nations coalition to prevent the spread of the Korean war into a larger conflict. Since the Korean war, there has been a fashion among critics of nuclear airpower to cite all of the brushfire wars that have broken out despite the exclusive possession by the U.S. of this capability. This seems to us to be viewing the situation through the wrong end of the telescope. The really important fact is that from the crisis of the Berlin blockade in 1948 forward no major war has developed. Every brushfire thus far has burned out within its geographic boundaries without spreading because this nuclear retaliatory force existed.

The U.S. monopoly on massive nuclear retaliatory capability began to dissolve in 1955 when the Soviet Union demonstrated that it had nuclear weapons and both medium and long range jet bombers with which to deliver them. More recently the Soviets have boasted of an intermediate range ballistic missile capability to supplement this jet bomber force. And there is reason to believe the Russian claims in this field have some solid basis.

At the time of the Suez crisis, the Soviet threat of missile retaliation played a significant role in checking the Anglo-French invasion of Egypt. Apparently encouraged by this reaction, Soviet Premier Bulganin is now playing this same card against the smaller NATO countries to bluff and scare them out of continuing in the solid phalanx of Western power.

Norway, Denmark and the Netherlands have been recipients of Bulganin's notes threatening massive retaliation if they take an active role in any military action against the Soviet bloc. Indications are that the NATO countries are not ready to change policy in the face of this Soviet bluster.

If this is true, the Soviets are in the position of a poker player who finds his hand not strong enough to stay in the game and must either lose his ante or pluck some new and hopefully better cards from the deck. It will be interesting to see whether the Soviet subsides in these missile threats or stages some spectacular public demonstration of its capability to back its hand. The latter was U.S. policy in staging its round-the-world nonstop flight of B-52 bombers demonstrating for all to see that our retaliatory power was no myth.

The combination of British dependence on USAF missiles and the development cycle looming for those missiles to become operational poses a critical problem for the next five years.

Will the B-52 fleet of the Strategic Air Command retain its current high degree of retaliatory potency for the full period before long range missiles can take over this function?

Or will we face a dangerous gap between the time the B-52 fleet is dangerously far down the obsolescence curve and the missiles become effective weapons?

Present outlook is that neither Britain nor the U.S. are preparing to develop a generation of interim weapons to fill this dangerous gap.

—Robert Hotz

The North American Super Sabre streaks for altitude at supersonic speed.

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WHO'S WHERE

In the Front Office

Gen. Thomas B. Wilson, board chairman, Resort Airlines of Delaware. Gen. Wilson succeeds **Clinton Davidson, Sr.,** who continues as president.

Ben Regan, board chairman, Frontier Airlines, Inc. Mr. Regan succeeds **Louis E. Leverone,** deceased. Also: **Preston Walker** and **Joseph E. Wagner,** directors.

Richard W. Hodgson, executive vice president and director of research, The Arnour Corp., Los Angeles, Calif. **Walter Y. Fish** succeeds Mr. Hodgson as vice president-engineering.

Lee S. Johnson, vice president, United Aircraft Corp., Bridgeport, Conn. Mr. Johnson is general manager of the Sikorsky Aircraft division.

Nathaniel Brewer, vice president-technology and chairman of the company's executive committee, Fischer & Porter Co., Hatboro, Pa. Also: **Alexander Greenfield,** director-research, development, engineering.

Donald C. Webster, vice president, Librascope, Inc., Glendale, Calif.

Dr. Royal Weller, vice president-engineering, Stromberg-Carlson, division of General Dynamics Corp., Rochester, N. Y.

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Horace Bolding, vice president-purchasing and stores, Braniff International Airways.

H. G. Sturgeon, deputy managing director, de Havilland Propellers Limited, Hatfield, Hertfordshire, England.

Edgar Allen (Pete) Goff, Jr., assistant to the president, Link Aviation, Inc., Binghamton, N. Y.

John W. Dregge, chief-routes division, and **Jacob W. Rosenthal,** chief-carrier relations and services division, Civil Aeronautics Board, Washington, D. C. Foregoing appointments were announced in connection with the reorganization of the routes and carrier relations division of CAB's Bureau of Air Operations.

Honors and Elections

The Air Research and Development Command, Baltimore, Md., was named recipient of the Daedalian Trophy for 1956 by Gen. Nathan F. Twining, USAF Chief of Staff. Gen. Thomas D. White, USAF Vice Chief of staff presented the silver cup to Lt. Gen. Thomas S. Power, Commander of ARDC. The trophy is presented annually to the USAF major command having the most effective aircraft accident prevention program.

Harry F. Guggenheim, president of The Daniel & Florence Guggenheim Foundation, has received the Laura Taber Barbour Award. The award, which is administered by Flight Safety Foundation, Inc., was created to recognize notable achievement in the promotion of safety in air flight.

(*Continued on p.* 181)

INDUSTRY OBSERVER

► Russia's Intermediate Range Ballistic Missile (AW March 12, 1956, p. 98) has a burning time of approximately 125 sec., a sea level thrust of aproximately 275,000 lb. Weight of the missile at burnout is about 15,000 lb.; gross weight at takeoff is approximately 150,000 lb. Missile is now fitted with rounded nose cone.

► **Polaris inertial guidance package will undergo acceleration and vibration tests this summer at the Supersonic Naval Ordnance Research Track, China Lake, Calif. Massachusetts Institute of Technology has the overall responsibility for the package which will be built by General Electric. G. E. also will build the shipboard fire control system for Polaris.**

► Packard-Bell received a contract for work on a chain of guidance stations throughout Africa in connection with the testing program for USAF's Thor, Douglas-developed Intermediate Range Ballistic Missile.

► **Boeing is proposing a new wing for the B-52 designed to give the strategic bomber a significant increase in range.**

► Wright Air Development Center Materials Laboratory has a high-priority Strategic Air Command requirement for a parachute that can withstand JP-4 jet fuel fires for periods of 4-10 sec.

► **Packard-Bell Aircraft received a substantial order for work on the guidance system for USAF's Thor Intermediate Range Ballistic Missile.**

► Industry is showing widespread interest in Army's aerial jeep competition. Army is now considering 28 designs from 21 contractors, some of them major Air Force and Navy weapon system builders. Typical entry measures 10 by 20 ft., carries a 1,000 lb. payload and has a limited range of about 25 mi. at a speed of 30 kt.

► **Bell Aircraft's XV-3 convertiplane is scheduled to begin tests within the near future in National Advisory Committee for Aeronautics' wind tunnel at Langley Field, Va.**

► Northrop received a new USAF order for an adidtional 50 Snark subsonic, turbojet-powered missile with intercontinental range.

► **Work is well advanced at Marquardt Aircraft Co. on nuclear ramjet engine, although powerplant has not yet reached the hardware stage.**

► Snecma is developing an acrodynamic afterburner system which eventually will replace the present mechanical flame catching device. The new technique consists of the injection of air (bled either from the compressor or from the combustion chamber) into the main jet flow so as to form fluid screens. These screens in turn set up micro-vortexes and thus facilitate the propagation of the flame.

► **Morane-Saulnier has registered its first civilian order for its four-place executive jet aircraft, the 760 Paris. Order was placed by the Shah of Iran.**

► Army conducted tests to determine flight characteristics of a helicopter with wings. Vehicle used in tests was old Piasecki HRP-1.

► **Convair will incorporate a skip flow gencrator into its upward ejection seat for high performance aircraft.**

► Monthly production rate for Dassault Super Mystere B.2 fighter-bomber is scheduled to reach 15 before the year's end. First production model was flown Feb. 27, and first French air force squadron using the B.2 is scheduled to be formed sometime this fall.

► **Army's air transportable Package Power Reactor prototype stationary nuclear power plant achieved a chain nuclear reaction for the first time earlier this month. Output of reactor, now undergoing tests at Ft. Belvoir, Va., will be 1,855 kilowatts.**

IN AIR TURBINE DRIVES

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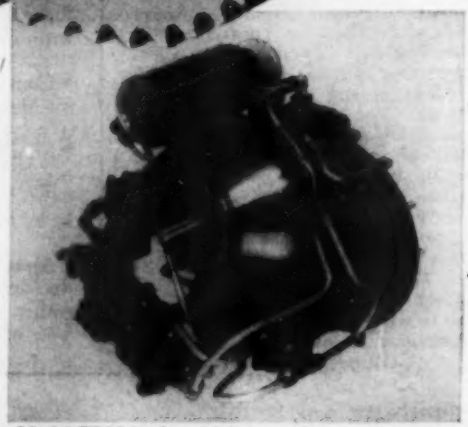


Model TP25-1, for driving a 15 kva alternator

Washington Roundup

Protest For R&D

Watch for increasing protests against the cool attitude of Pentagon civilian administrators toward research and development. Rear Admiral John E. Clark, Director of Guided Missiles for the Chief of Naval Operations pointed the way last week in a speech to the Institute of the Aeronautical Sciences at Cleveland.

In defense of multiple development projects, Adm. Clark said that fast progress has been made but the reliance on one approach to the missile problem could have resulted in no missile at all and a huge waste of money. He also cited the case of an automobile company that paid the way for 12 developments before settling on one automatic transmission for production. The Navy, in contrast, has selected two air-to-air missiles out of six development projects. Adm. Clark quoted a General Motors Corp. executive and scientist as saying that "guided missile problems must be approached from the research rather than the design point of view."

Vanguard Cost

Total cost of the Vanguard satellite program may never be known. Funds are provided separately from regular Defense Department appropriations by the Bureau of the Budget. Other branches of the armed forces, in addition to the Navy, are providing facilities and manpower. Navy Secretary Thomas S. Gates, Jr., says the Budget Bureau already has been asked for additional funds to finance the project. Meanwhile, the initial rocket engine delivered by General Electric Co., was turned down by the Glenn L. Martin Co., prime contractor in the Vanguard project, for failure to meet specifications. Secretary Gates says corrections will be easy and will not delay the firing, which he expects to take place late next year.

Overselling Penalty

Civil Aeronautics Board will soon take formal action against scheduled airlines that have been deliberately overselling flights as a hedge against no-shows. James Anton, chief of CAB's compliance section, told the House Commerce Committee last week that complaints had been drawn up and will be filed shortly against "flagrant" violators who still persist in overbooking flights despite earlier warnings by the CAB.

In another move, the Air Traffic Conference adopted a $3 no-show penalty ruling to go into effect on Sept. 15 if approved by the CAB. The airlines, however, modified the minimum time limit on ticket pickups to 30 min. before flight time, although reservationists will encourage earlier ticket pickup. A reconfirmation ruling requiring passengers to confirm return and continuing space six hours before departure time will be re-established July 15.

Permanent Certificates

Outlook is good for the enactment of legislation providing permanent certificates for domestic all-cargo carriers. Senate Commerce Committee already has approved the measure. Carriers that would be affected are: Slick Airways, The Flying Tiger Line, Riddle Airlines, and AAXICO.

Meanwhile, Chairman Warren Magnuson (D., Wash.), of the Senate Commerce Committee, has introduced legislation providing permanent certificates for carriers operating between the U.S. and Alaska—Northwest Airlines, Pacific Northern Airlines and Alaska Airlines.

Information Clash

Members of the House Government Information Subcommittee are clashing with top Defense Department information officials as to whether recent directives issued by Defense Secretary Charles Wilson will increase or cut off the flow of information to the public.

The directives are a partial implementation of the recommendations of a special advisory committee headed by Charles Coolidge (AW Nov. 19, p. 28). A new series of directives to complete implementation is expected.

Subcommittee Chairman Rep. John Moss (D., Calif.) charged that the recommendations "erect new and higher barriers to the flow of information."

Robert Dechert, the Defense Department's new general counsel, denied this and Murray Snyder, new Assistant Secretary of Defense for Public Affairs, promised that "several months from now we will be able to produce a record that will be consistent with the objectives of the subcommittee and with the objectives of the news media that have been so zealous in fighting for and protecting the peoples' right to information."

There was unanimous agreement on one point: That the flow of information hinges largely on the "attitude" of the responsible information personnel.

Moss commended Dechert and Snyder for being "helpful and cooperative"—a sharp contrast to the continual charges of obstructiveness directed by him to former Assistant Secretary of Defense for Public Affairs, Robert T. Ross.

Flight Recorders Too High?

Airline industry is objecting to the proposed installation of flight recorders on all aircraft because of the cost involved. During oral arguments last week before the Civil Aeronautics Board, which is considering the proposal, it was estimated that the initial costs to airlines would total $6 million. The device would record altitude, compass headings, speed and time and is built to resist terrific impact and fire. The information recorded would be valuable in the event of a crash. Hearings are being held to determine whether the CAB should order airlines to install the recorders.

Northeast Stock Case

Sen. Henry Jackson (D., Wash.) will preside at hearings—scheduled to start May 1—on an alleged "leak" of information from the Civil Aeronautics Board last fall on the award of a New York-Miami route to Northeast Airlines. The staff of the Senate Permanent Investigating Subcommittee completed an investigation late last year, and the case has been on the agenda for hearing since the session convened in January. It was postponed because of the occupation of Sen. John McClellan (D., Ark.), committee chairman, with labor racketeering hearings before another committee. It now has been agreed that Sen. Jackson, second ranking member, will take over the case. Hearings are expected to last no more than two or three days.

—Washington staff

CAA Proposes Expanded Airways Plan

Six-year plan drafted to break traffic bottleneck; Vortac coverage would be provided entire U. S.

By L. L. Doty

Washington—Details of an expanded airways plan that calls for complete Vortac coverage over the entire U.S. up to 75,000 ft. by 1962, were disclosed last week by the Civil Aeronautics Administration.

The vast project, which embraces CAA's original telescoped three-year plan and also proposes eventual automatic control of traffic, is a major step toward a breakdown of traffic bottlenecks through the use of electronic computers, Vortac and a radar system that includes long-range, airport surveillance, precision approach, secondary and surface detection equipment.

Full implementation of the program, to be known as the six-year federal airway plan, is scheduled for 1962. By then, CAA predicts it will be handling 25 million civil aircraft operations annually as compared with 15 million last year. Cost of the system—$810 million for facilities, $425 million annually to operate and maintain.

What Plan Provides

Highlights of the projected system which underscores increased traffic capacity and extended coverage as basic objectives:

- **Elimination** of the incompatible four-course L/MF range facilities and the implementation of rho/theta (distance-bearing) coverage on existing and planned airways as low as 700 ft. above the ground. Additional rho/theta facilities and terminal aids will be established on airways and airports expected to generate increased volumes of traffic in the future. To handle high-altitude turbine aircraft, interference-free rho/theta coverage from 18,000 ft. to 75,000 ft. will be established over the entire U.S.
- **Additional rho/theta facilities** will be placed into service on high-density airways and airports to permit lateral separation of aircraft on multiple-express airlanes and on in-and-out airport routes.
- **Victor airways (VHF)** will be revised to reduce traffic conflicts and permit wider use of express airways.
- **Stratification of air space** to allow safe segregation of long-haul and short-haul traffic and to permit climb and descent tracks to and from high-altitude strata.
- **Installation of precision approach aids** with ILS and intensity approach lights as a means of reducing visibility and ceiling minimums.
- **More flexibility in the use of radio fixes** by employing distance measuring equipment and tracks for position reporting at critical points.

Warning From Pyle

Administrator James T. Pyle warned that success of the plan depends largely upon full-scale research and development, particularly in the later stages of implementation. He said a "development plan" will be introduced this year to augment airways evaluation projects conducted by the CAA Technical Development Center.

However, Pyle told the House Appropriations Subcommittee that the $2.8 million requested in the Fiscal 1958 budget for Technical Development Center operations represented about one-third of the research effort contemplated. Earlier, Lloyd Perper, a member of the Aviation Facilities Planning Group headed by Edward Curtis, predicted that adequate evaluation facilities would cost up to $50 million a year.

The plan has been endorsed by presidential aide Curtis and was approved by the Air Coordinating Committee after a three-month review of the proposed system.

The six-year plan closely parallels the basic Curtis plan as it is now known. However, differences on the subject of positive control of all air traffic may arise. Curtis has indicated that the "see-and-be-seen" principle must be retained in some areas, but Pyle has asserted that all traffic will be under some sort of positive control within five years.

Vortac Largest Item

Largest item in the program is Vortac, which was adopted last September in a compromise agreement between civil and military aviation to combine the rho features of Tacan with the theta features of VOR (AW Sept. 3, p. 41).

The Vortac program has been given top priority by the CAA, and funds for its installation amount to $255 million, or almost one-third of the total cost of all facilities required for the six year plan. Annual maintenance and operation cost of Vortac is estimated at $72 million beginning in 1962.

Commerce Secretary Sinclair Weeks said the Maritime Administration's ship construction program had been reduced by $25 million to absorb the cost of the initial Vortac program. First installation of a Vortac ground unit is at Phillipsburg, Pa.

Basic coverage of Vortac will be upwards of 700 ft., and signals will provide "all airspace" coverage above altitudes of 18,000 ft. mean sea level. CAA has determined that Vortac must be installed in a crash program at 300 locations before 1960 in order to meet civil and military jet requirements. Pyle has admitted that the unexpected surge of orders for jet transports "caught us by surprise."

A total of 1,230 Vortac installations are scheduled for completion by 1965. Commissioned distance measuring equipment in the present system will be retained until 1960 except where frequency conflict demands a phasing out of the units. No further DME will be installed. Existing VOR units will be suitably modified to integrate Tacan capability.

Expanded Radar Coverage

An important key to the over-all program is the expansion of radar coverage. Use of long-range radar, airport surveillance radar (ASR) and the air traffic control radar beacon system (secondary radar) will allow better utilization of airspace and a reduction of controller workload.

Tied-in with airways radar is the further development of better displays that will stand-up under daylight conditions. Projection techniques are now under evaluation study at CAA's Technical Development Center (AW Oct. 29, p. 40).

Long-range radar is expected to relieve traffic bottlenecks by separation of aircraft on a spot basis in place of the restrictive time separation now required.

First phase of the long-range radar program calls for the implementation of extended terminal area coverage during the Fiscal Years 1957 and 1958. At present, long-range radar is in operation at the Washington air route traffic control center, and FPS-8 equipment has been supplied by the Navy and Air Force at New York and Norfolk pending CAA procurement of long-range units.

The immediate plan provides for complete overlapping radar coverage between Boston and Norfolk for trial use of the system.

En route coverage for congested airways and high altitude coverage—above 15,000 ft.—is scheduled for installation in 1958 and 1959. Although the plan indicates a need for 73 long-radars, CAA feels this will be insufficient for full coverage. An interchange of radar systems between the CAA and the Air Defense Command is anticipated as one means of absorbing a part of this

deficiency and a joint CAA/ADC planning group has been established to study radar requirements.

CAA warns that additional funds will be required for the long-range radar program to cover future costs of new electronic features, introduction of improved equipment and relocation of facilities as found necessary by operational experience. Total cost of long-range radars is expected to reach $86.6 million during the six year program. Maintenance and operating costs will amount to $71 million annually.

Airport surveillance radar and military radar approach control facilities such as RAPCON will continue to be important parts of Common System. ASR will be implemented at all major transportation hubs, or at any airport having CAA airport traffic control service and 2,000 or more annual instrument approaches.

A total of 70 ASRs will be installed during the next six years in addition to the 45 currently in operation.

Precision approach radar will be established in 20 locations during the next six years. Twenty-three are now in operation. Criteria of 3,000 or more instrument approaches annually as a standard for PAR installation is now being met by several airports but procurement has been temporarily shelved in favor of other equipment considered of greater importance.

Surface Detection

Airport surface detection equipment (ASDE) for use in ground control of traffic has been under CAA evaluation study since 1951. Extensive tests were undertaken at Indianapolis and Minneapolis and final operational tests were made at Idlewild Airport, New York.

CAA expects to place orders for ASDE in Fiscal 1958 provided additional evaluation supports earlier findings. If demonstrated to be satisfactory, ASDE will be installed at 74 locations.

Total procurement and installation cost of ASR, PAR and ASDE will amount to $58.5 million. Operation and maintenance costs will be $59.5 million a year.

Air traffic control radar beacon system or secondary radar will cost $24 million. The radar beacon is still in the development stage, but CAA hopes to install 188 beacons for civil surveillance radar systems by 1962 and an additional 42 for all operating and planned civil PAR systems.

Tests on partially completed components of the beacon system have been conducted since 1954, and a nine station in-service testing of the system will begin as soon as all components are available. The beacon program is sponsored by the Air Navigation Development Board.

CAA is actively pursuing a development program involving the automatic collection, processing, transfer and display of control data in a move to eliminate manual performance of control functions by controllers. Electronic data processing (datamation) techniques are now under development at the Technical Development Center (AW Nov. 12, p. 83).

First phase of the system calls for automation teletype switching centers to route messages to proper centers where they will be fed into digital computers and magnetic storage drums.

Biggest barrier to the use of electronic data processing techniques is that centers receive aircraft flight plan information in void form—a form computers cannot accept. However, Pyle is optimistic over the potential of the new techniques and says "automation holds real promise for the future" but admits "it is still pretty far in the future."

Other Projects Planned

Other projects planned by CAA for the six-year plan:

• **Air route traffic control centers.** A small number of new centers may be established to ease workload and reduce costs of remoting radar and data communications. A total of $103 million will be required for relocation of centers, improvements to accommodate radar equipment and expanded quarters to align control functions efficiently.

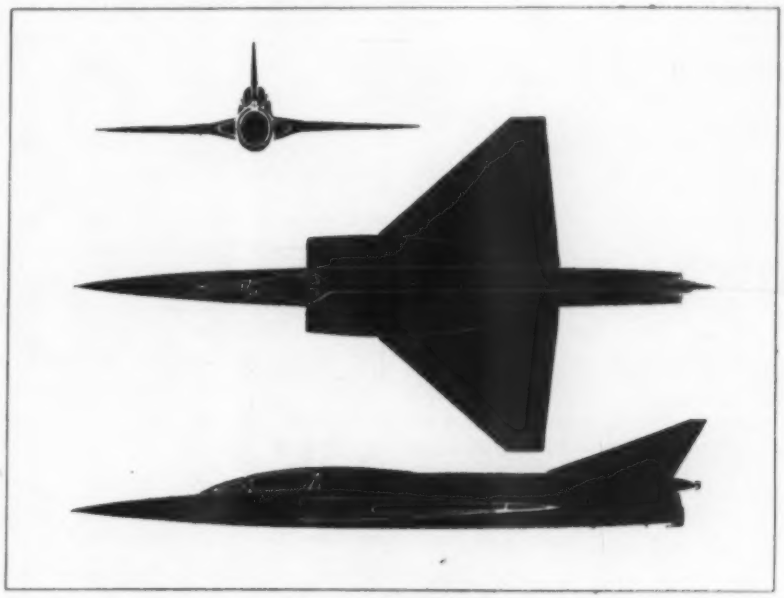
• **Direct center controller-pilot** radio telephone service. Plans call for radical improvement of air-to-ground communications. CAA wants to eliminate airline intermediaries in communications and provide direct communication between controller and pilot.

• **Airport Traffic Control Service**—$29.8 million is needed for improvement, relocation and modification of control towers. The plan provides for the addition of 77 towers during the next six years.

• **Phasing out of various navaids** is expected during the next six years. These include 75 mc fan markers, 185 L/MF non-directional radio beacons, 832 airways light beacons. The number of airway light beacons reached a peak of 2,020 in 1945.

• **Direction finding equipment.** VHF/UHF DFE will be installed at all long-range radar and ASR locations. Delivery of the first 60 sets is now in progress, but no installations are programmed for Fiscal 1958 because of more pressing requirements.

• **Instrument Landing System**—$58 million is allocated for ILS installation during the next six years. This will include the addition of 119 ILSs to the 158 now in operation. Future budget requests will provide for the addition of a second ILS at airports bogged down by heavy approach traffic. ACC has recommended phasing out of DME equipment and the addition of Tacan distance equipment to 70 ILS's by 1960 to meet jet transport requirements. All ILS eventually will be so equipped.

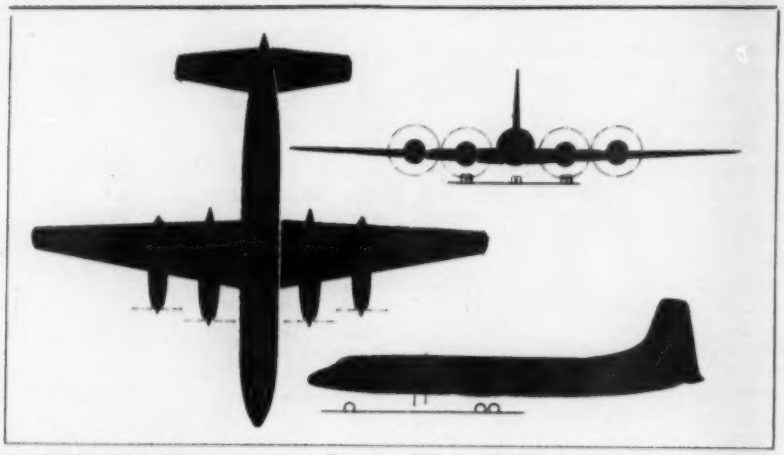


Spanish XC-6

Spanish XC-6 supersonic, delta-wing light fighter designed by Germany's Willi E. Messerschmitt for Hispano Aviacion S. A. is powered by a Bristol Orpheus turbojet engine. Proposed armament for the area ruled fighter includes two 30 mm. Hispano cannon.

TRANSPORT VERSION of Canadair CL-28, ordered by RCAF will be offered in civil version. Design is based on Bristol Britannia.

Canadair Re-Enters Transport Market



DIMENSIONS of airliner are same as Britannia 310: length 124 ft., span 142 ft.

Montreal—Canadair, Ltd., which will build under Royal Canadian Air Force contract a Bristol Orion turboprop-powered version of its CL-28 maritime reconnaissance plane, will offer a civil transport version to international airlines, priced at approximately $3½ million.

Under an agreement with Bristol Aeroplane Co., Canadair acquired world sales rights for a commercial cargo version, limited sales rights for the civil transport version in the U. S., Canada, the Scandinavian countries and Switzerland, and conditional rights in various countries for the military transport airplane. It has exclusive world sales rights for the CL-28.

Canadair Versions

The RCAF order and subsequent Canadair civil offer brings into existence a Canadair design family sired by the Bristol Britannia, which is powered by Bristol Proteus turboprop engines.

Canadair's versions of the airplane:

- **CL-28,** designated the CP-106 Argus by RCAF. Powered by Wright 3350 Turbo-Compound piston engines for long range at low altitudes, this airplane retained wings and tail of Britannia but has extensive fuselage changes for its military anti-submarine mission.
- **CL-44** transport version for RCAF. Using the 5,000-eshp. Orion, it will carry 120 passengers or a maximum payload of 45,000 lb. of cargo. Cruising speed will be about 400 mph., range 4,000 mi.
- **Civil version,** designated the CL-44 also, pending possible name choice by a customer.

Dimensions of the RCAF version, designated CC-106 by that service, are the same as the Britannia 310 long range transport: 124 ft. long, 10 ft. longer than the CL-28 fuselage; 142 ft. span and 36 ft. 6 in. height, same as the CL-28.

First RCAF deliveries are scheduled for late 1959. Because many of the same jigs, tools and fixtures can be used from the CL-28, now in production, cost saving will be substantial.

RCAF contract was described only as a multi-million dollar order. However Canadian government officials have referred in Parliament to an order of eight. Total production undoubtedly be larger, for the RCAF to lighten the effect on Canadian budgets usually orders aircraft in small batches over a period of several years.

RCAF Replacement

Transport will replace RCAF's North Stars. Seventy of these Rolls-Royce Merlin-powered transports based on the Douglas C-54 and DC-6 designs were built. Trans-Canada Air Lines operates North Stars, but is committed to a Vickers Viscount and Vanguard re-equipment program. Canadian Pacific Airlines, with five Britannias on order at a cost of $3 million each, is a potential CL-44 customer.

Canadair has sought to re-enter the commercial transport field since the end of the North Star program seven years ago and its abortive CL-21 proposal for a DC-3 replacement.

The Orion engine, flown in a Britannia test bed since last August, is twin-spool supercharged engine which is, in effect, an 8,000 eshp. engine but governed to deliver a constant 5,000 eshp. from sea level to 15,000 ft. This, Bristol says, will permit the aircraft it powers to take off at maximum gross weight from any airport in the world, irrespective of elevation.

Orion will develop 3,800 eshp. at 30,000 ft., which, Bristol says, is 50% as much power again as a conventional turboprop at the same altitude. At cruising altitude, Bristol says, the Orion fuel consumption is superior to turbo-Compound piston engines.

In territories where Canadair has rights, Canadair is prepared to supple-

ment the number of Britannias that will be built. Commercial sales effort for the transports will be coordinated with Bristol.

Canadair is a subsidiary of General Dynamics Corp., whose Convair Division produces the Convair 440 twin piston-engine transport and is starting production of the 880 turbojet transport.

Sales program also will be at least informally coordinated with Convair. As an example, Canadair now is close to having sold the RCAF Convair 440 transports.

Inertial Navigation Flew B-29 Across U.S.

Inertial navigation system developed by Massachusetts Institute of Technology Instrumentation Laboratory has automatically flown an Air Force B-29 from Boston to Los Angeles, bringing it within "less than 10 miles" of its intended destination.

The flight took place on February 9, 1953, using experimental equipment which weighed more than a ton, but equipment size and weight have since been slashed.

Dr. C. S. Draper, head of MIT's Instrumentation Laboratory who disclosed the flight last week, predicts that present inertial guidance system accuracies can be improved by a factor of 10 in the next decade. MIT currently is developing an inertial navigation system for use with the Navy's Polaris, Intermediate Range Ballistic Missile.

USAF Changes Plan, Gives Firm Schedule to Nuclear Plane Project

Washington—Air Force is putting its nuclear aircraft project back on "permanent" status with the first flight scheduled for sometime in the mid-1960s.

USAF's decision to "restore a definite timetable" for the project was reported by Rep. Melvin Price (D., Ill.), chairman of the Joint Congressional Atomic Energy Subcommittee on Research and Development, after a series of executive sessions with USAF Secretary Donald A. Quarles.

Price, who earlier protested the Air Force's original decision to take the nuclear aircraft project off a definite schedule and reduce its budget (AW Mar. 11, p. 30), said that he is "reassured" but "not satisfied" with USAF's new approach.

Price told AVIATION WEEK that "there are no technological barriers serious enough to warrant a slow-down" of the project. "On the contrary, they are challenges for additional effort," he declared.

Quarles told Price's subcommittee that USAF had reviewed the project because, with development, the plane became heavier and slower, and that USAF is now seeking to design a more compact engine with lighter shielding, postponing the actual design of the aircraft.

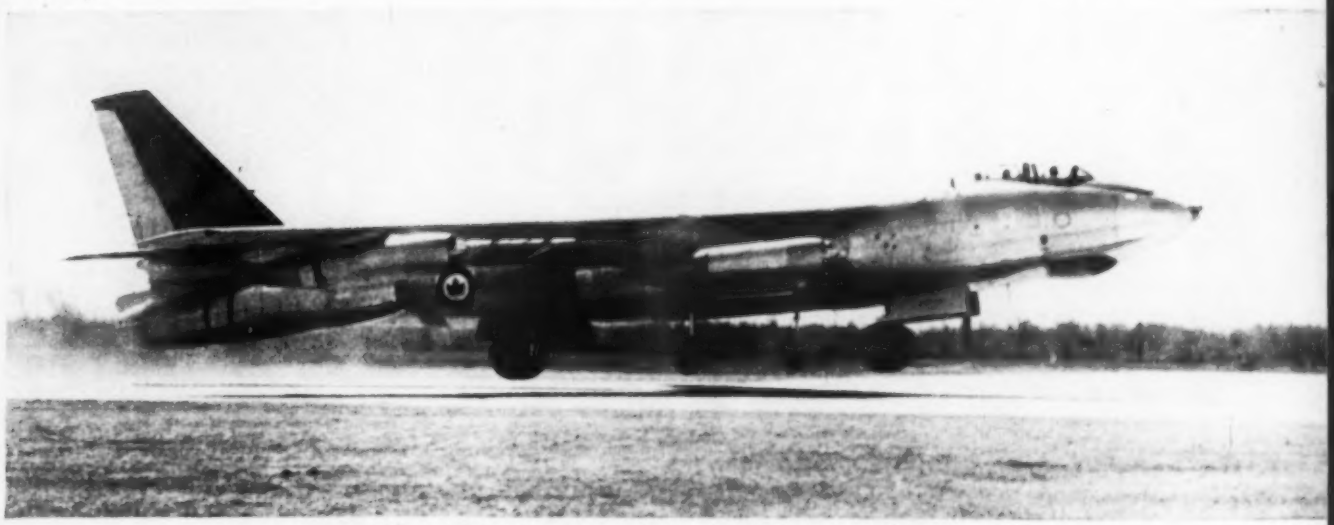
The ANP project is now at a level of approximately $200 million annually. This is about half the amount requested for Fiscal 1958 by USAF last fall.

Price reported that the Air Force has also given assurances that the organization for handling the various segments of the ANP program would be streamlined to give "tighter over-all supervision." He said this will "only partially" meet his proposal that a single administrator "with sufficient authority to get the job done" be appointed for the ANP program.

"Contractors have met their schedule," Price said. "The main difficulty is in the Pentagon where administrative confusion and indecision over research and development objectives have marked the conduct of the program." He said that "at least putting the program back on a timetable will eliminate the apprehensions of contractors that at any time the project will be tossed out."

Present contractors are Lockheed and Convair for airframes, and General Electric and Pratt & Whitney for engines.

Price also criticized the Navy for "sitting back and not being sufficiently interested" in the atomic plane program. Navy should be "actively participating" in it, he declared, with a view to seaplane development.



B-47 Test Bed for Iroquois Takes Off

Modified B-47 test bed for Orenda Engines PS-13 Iroquois turbojet takes off in first flight at Montreal. The aircraft, modified by Canadair, Ltd., was flown to Malton, Ont., where Orenda will install final instrumentation and engine prior to beginning flight tests in a few weeks. B-47 was chosen as test bed for the Iroquois because it was the fastest aircraft available capable of carrying the new engine. Primary engineering problem was attaching the Iroquois so that buffet speed of the B-47 was not reduced. The required subsonic tests had to be conducted at the B-47's maximum speed and altitude. Problem was solved after an extensive wind tunnel program at Seattle, Wichita, Ottawa.

Trident II Backed as Standard Fighter

Four European companies agree to pool efforts to build French design, press for common use.

By Robert Farrell

Paris—Four important airframe builders in western Europe have decided to pool their efforts in promoting the French-designed Trident II as the standard interceptor for western European defenses.

Sud Aviation, French builder of the Trident, reportedly has an agreement to this effect with the Belgian airframe company, SABAC, and the Dutch firm of Fokker. In addition to these three firms, a West German airframe company is a party to the agreement.

The agreement between the four firms states that the Trident is the interceptor best suited for the special defense needs of western Europe. The companies state further that they are willing to build the Trident in common and that they intend to press their individual governments to support the project.

The four-way accord is highly significant for the western European airframe industry. Cooperation between European airframe companies has long been advocated as the only solution to continental aircraft production problems (AW Oct. 15, p. 21). The agreement is also unusual in that for the first time European companies are telling their respective governments which aircraft they think should be built. The normal procedure in western Europe is for governments to take the lead, with the companies rarely ever expressing their opinions publicly.

Actually, the agreement was signed several months ago in Paris following a series of unpublicized tests made on the Trident by the various companies. Since then the French Air Ministry has held up any announcement on the accord. Last week in Paris, Georges Hereil, Sud Aviation president, said he could neither confirm nor deny the deal. The agreement, however, has been substantiated by AVIATION WEEK.

Durandal Shelved

By backing the Trident, built originally by Ouest Aviation—the French airframe company recently merged into Sud Aviation—the latter company apparently has decided to shelve its competing interceptor, the delta-wing Durandal.

The Trident II is a lightweight interceptor designed eventually to operate at Mach 2 speeds and above. Powered by SEPR liquid propellant rockets in the tail and two wingtip jet engines, the straight-wing Trident has flown in the Mach 1.9 range. Sud Aviation presently has an order for ten pre-production Tridents from the French Air Force.

Trident, first flown in July, 1955, was designed specifically to meet both the military and economic needs peculiar to western Europe. Generally, the military needs call for a Mach 2 interceptor operational at a minimum altitude of 50,000 ft. Despite the high-speed requirement, the interceptor must have a low landing speed and be capable of getting in and out of short fields. Range is not stressed. With the distance between the enemy and the interceptor's base considered nil, one hour's flying time is judged sufficient for carrying out the interceptor's mission.

Economic requirements in western Europe are usually dictated by lack of funds and lack of "elbow room." Long airstrips are expensive to build, and in western Europe it is often difficult to fit them into the already crowded landscape without stirring up local interests. More important, thin military budgets in western Europe require that the ideal interceptor be inexpensive, easy to build and cheap to operate.

Meets Requirements

The companies signing the agreement claim the Trident II fully meets these military and economic requirements.

Trident can land and take off within 500 yards. Fitted with low-pressure tires, it can use grass or other unprepared landing areas. Despite its Mach 2 speed, the Trident lands at 90-100 kt. Reportedly the aircraft is no more difficult to fly than a jet trainer and its instrumentation is said to be less complicated than most World War II fighters. For example, complete power control for the two-chamber tail rocket engine operates off one lever.

Production layout for the Trident has been simplified to the point where manufacturing costs are said to represent only 20% of the total cost. It has been estimated that at least four Tridents can be built for the price of one USAF F-104. Extensive use of honeycomb material and metal-to-metal bonding has produced a light airframe of extreme rigidity. Gross weight of Trident II is 11,355 lb., allowing 5,788 lb. for equipped empty weight, 242 lb. for pilot, 330 lb. for air-to-air missile carried externally under fuselage, and 4,995 lb. for fuel and oxidizer.

Trident's low aspect ratio wing is simple box arrangement using honeycomb material and metal-to-metal bonding. Profile and chord are constant over entire span. Complete wing consists of only four or five different elements. It appears that such elements as the four full-span, high-lift flaps as well as the leading edge sections are interchangeable. Same is true for the three trapezoidal tail surfaces. Overall wing span is 22 ft., 6 in. while wing area is 155 sq. ft. Height is 10 ft. 3 in.

Classic Construction

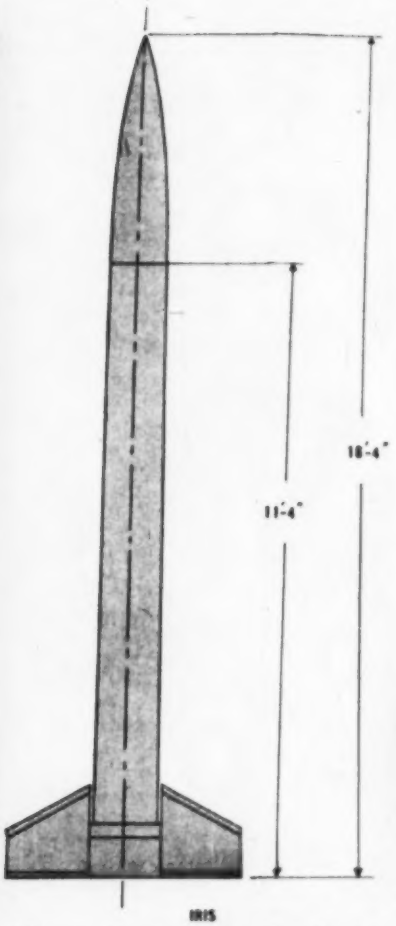
Trident II fuselage is of classic construction composed of perfectly circular frames and longitudinal stringers. Length is 42 ft., 6 in. Nose section includes pressurized cabin with jettisonable canopy and a light ejector seat. All hydraulic, electrical and radio equipment is housed in a single unit behind the pilot. Mid-section of fuselage contains the fuel and oxidizer tanks which can be rapidly jettisoned. Upper aft section of fuselage houses two airbrakes while rocket engine is contained in lower part.

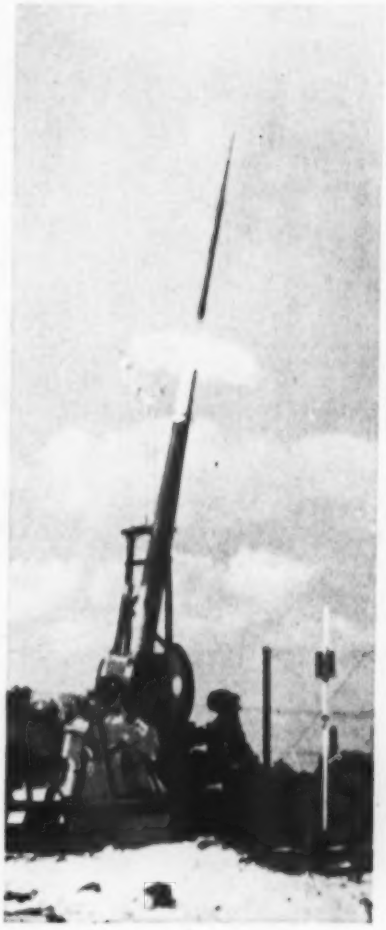
It is understood the area rule concept was considered for the Trident II but was finally rejected by Designer Lucien Servanty. Many French designers think the area rule concept loses its validity at speeds beyond Mach 1.4 in that the advantages gained are offset by design complications.

Trident tricycle landing gear retracts into fore section of fuselage. Gear is lowered under combined effect of its own weight, induced drag and a pneumatic booster.

Control of the aircraft is carried out entirely by tail unit of three one-piece surfaces which pivot freely around their axes and which are actuated by irreversible servos. Vertical surface acts as rudder while other two surfaces insure bank and pitch control. Whole unit is operated by conventional cockpit controls. With wing ailerons thus eliminated, it was possible for designer Servanty to install the high-lift flaps along the entire wing span to facilitate low landing speeds.

Present version of Trident II is powered by a pair of Dassault-built Armstrong Siddeley Viper turbojets of 1,650 lb. thrust each, plus two-chamber SEPR liquid-propellant rocket engine installed in tail and delivering maximum ground thrust of 6,615 lb. Rocket engine is prime mover, with each chamber being operated separately or in unison. It is probable that most of the ten pre-production Trident IIs now being built by Sud Aviation will be equipped with a pair of wingtip Turbomeca Gabizo jets of 2,400 lb. thrust plus afterburners.





Navy Sounding Rockets

First picture of Arcon upper air research rocket (left), shows vehicle being developed by Atlantic Research Corp. for Naval Research Laboratory on a Bureau of Ordnance contract (AW Oct. 1, p. 29). Atlantic also is developing larger research rocket, Iris (diagram), for NRL. Arcon, with 6 in. diam. and overall length of 11 ft. 2 in., will carry a 40 lb. payload to 70 mi. It is single-stage, solid propellant, weighs 250 lb. Nose cone in this picture is not one which would be used in actual firings. Solid-propellant Iris will carry 100 lb. payload to 200 mi. It is intended as a replacement for liquid-propellant Aerobee-Hi, which is more difficult to handle on shipboard. Also shown is Hasp, (High Altitude Sounding Projectile) (right), which is based on Army Rocket Loki. Hasp will be fired from shipboard 5 in. guns, will seek temperature and humidity data at altitudes of more than 20 mi.

Briton Sees Waste in French Parca Missile

London—Member reported to Parliament this week on a French guided missile called Parca which he had seen at the French Vernon research establishment. He said it bore a close resemblance to an early British ground-to-air weapon.

Conservative James Hutchison said France had spent $28 million on it.

"What a waste in scientists' time and money," Hutchison asserted. "It cost 10 million pounds ($28 million) to develop a weapon which seemed to me almost identical to a weapon produced by us two or three years before—and I dare say that we were one or two years behind the United States. . . ."

X-17 Travels 700 Mi.

Lockheed Aircraft's X-17 hypersonic test missile recently reached an altitude of over 600 mi. and travelled more than 700 mi. in an unplanned demonstration of its capabilities.

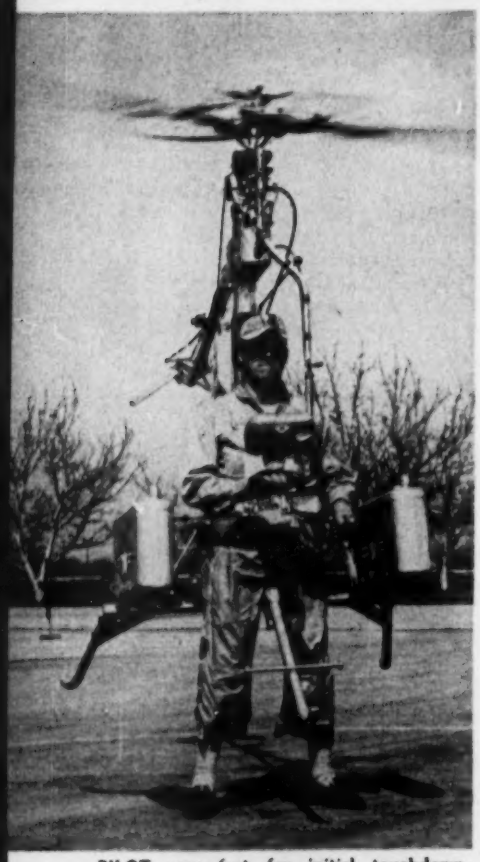
The distance and altitude marks were set when the three-stage missile failed to tip over, and the rocket motors normally used to drive it downward as part of USAF's re-entry tests in the Intercontinental Ballistic Missile program fired it to new heights. Normal range of the vehicle is about 200 mi.

Air Research and Development Command's Western Development Command, which has fired approximately 20 of the test missiles to date from USAF's Missile Test Center, Patrick AFB, Fla., has substantially completed work with the X-17.

Of the total missiles fired, 17 functioned perfectly, successfully duplicating the re-entry conditions of an ICBM in that the combination of the speed, altitude and dense air encountered in the X-17 tests were roughly equivalent to the conditions an ICBM will encounter at its higher altitude, higher speed and thinner air.

The X-17 program may now be taken over by the Navy to help accelerate the development of its Polaris Intermediate Range Ballistic Missile.

PEROXIDE provides fuel for Pinwheel.



PILOT uses feet for initial touchdown.

Simple Rocket-Powered Copter Demonstrates Use for Infantryman

By Richard Sweeney

Van Nuys, Calif.—To meet a design goal of a short-range, light, simple helicopter which any foot soldier can strap himself into quickly and operate efficiently, Rotor-Craft Corp. has built a monopropellant rocket powered helicopter dubbed "Pinwheel."

Capable of carrying a fully equipped infantryman plus additional ordnance, such as a flame thrower or 75-mm. recoilless rifle, the Pinwheel has been under development since 1950 with Office of Naval Research and company funds. It was demonstrated publicly last week.

Design Details

Features include:

• **Ultra simple propulsion system,** in which 90% hydrogen peroxide is fed into fully throttlable engines, one in each rotor blade. These are primarily metallic catalysts which cause peroxide decomposition. Resulting high velocity steam jet propels free rotating blades by exiting through a single nozzle in each blade tip trailing edge. Engines are buried in blade tips, produce only slight variation in blade profile.

• **Uncomplicated fuel system.** Dual tanks mounted on each side of pilot's saddle supply fuel to engines simultaneously through rotor head. Initially, fuel is pumped to engines by pilot-operated hand wobble pump. As propellant reaches engines and blade rotation starts, a fuel pump located in the rotor head and actuated by blade rotation takes over at about 200 blade rpm.

• **Starting procedure** that complies with original design concept. Observed starting procedure consisted of checking emergency fuel shutoff valve for open, operating wobble pump until fuel reached engine, where decomposition started and steam began blade rotation. Working throttle with left hand while his right operates wobble pump, pilot starts machine while in the seat and without any assistance. The helicopter has no ignition, no wiring in propulsion system. No ground support is required except refueling equipment, which under field conditions can consist simply of a drum of hydrogen peroxide and a hand cranked pump to bring fuel from drum into Pinwheel tanks.

• **Logical, simple control system.** Lever on lower left side of pilot's saddle is lifted to gain altitude, lowered to descend. Twist grip on the lever is the throttle. It is twisted outboard for higher rpm., inboard for slower. Tube comes down from the rotor head assembly over the pilot's head to a position in front of him. Mounted at the bottom of the column is a second control handle. Rotation left or right controls direction. Pushing it forward or pulling it back controls horizontal airspeed.

Only two gages are used on the copter, a blade tachometer and airspeed indicator, both mounted in a small housing on the control tube just above the front control handle. Presently, airspeed pitot head is attached to this case, just a few inches ahead, but readings obtained in this rotor-downwash disturbed area indicate a new pitot head location is desirable.

Green line operating limits for rotor speed are 640 to 740 rpm.

Pinwheel weighs about 150 lb. dry. Fuel capacity is 10 gal., giving machine a flight endurance of about 10 min. Indications are that redesign of jet exit nozzle can increase thrust as much as 50%. This can add to range, reduce fuel consumption, or get desired range from reduced fuel load, enabling soldier to carry more ordnance.

Rotor Diameter

Pinwheel metal rotors are 17 ft. in diameter, have a 5-in. chord. Tail rotor is single blade, belt driven. In addition, two horizontal stabilizing fins about 1 ft. in span and 5 in. in chord are mounted aft of the directional rotor, have anhedral of about 25 deg.

The machine rests on tripod leg system. Landing is affected first on pilot's feet, and then the helicopter is allowed to drop a few more inches onto the tripod. Ascent can be with pilot's feet on small footrest in front of him, or with feet on ground position.

Test pilot Richard Whitehead flew Pinwheel at speeds up to 75 mph. in the demonstration. Only real limit seen at present is wind blast on unprotected

Ryan X-13 Converts

USAF's jet-propelled VTOL research plane, the Ryan X-13 Vertijet, has gone through its first complete and continuous flight sequence at Edwards AFB, Calif.

Starting with a vertical takeoff, Ryan test pilot Peter F. Girard put the X-13 into horizontal flight, returned it to a hovering attitude and then landed.

There are two X-13's now at Edwards. The research models have been taking part in an 18-month flight test program. Purpose of the project is to test the feasibility of jet-powered VTOL.

pilot. The machine is so constructed that addition of a small "outboard" type motor on aft section driving a pusher propeller, could add substantially to the machine's forward speed or add range by producing an autogiro-type flight.

Combination of Pinwheel's design parameters have resulted in a machine with excellent autorotation characteristics. In case of fuel exhaustion or engine malfunction, valuable blade kinetic energy is not dissipated in disconnecting rotors from a drive shaft, and no clutches are used in the system, which essentially is autorotating blades with tip powerplants. Company says machine's autorotation rate of descent is 22 fps., approximately the same as that of a parachute. Weight of engines in blade tips plus machine's low disk loading join with other design features to produce, just before touchdown from an autorotation descent (which can be safely started in Pinwheel much lower than in conventional helicopter), a momentary hovering condition, giving pilot an even better chance for a very light touchdown.

Altitude Performance

Pinwheel's rocket engine has no altitude limitations. Only limits are pilot's oxygen needs and fuel. The helicopter has been test flown at pressure altitudes of 8,000 ft., and it has been flight tested from Denver's Stapleton Airport, more than 5,000 ft. above sea level.

In developing Pinwheel, which can be transported, stored or hangared in a wooden box 9 ft. 3¼ in. long, 25¼ in. wide and 32 in. high, Rotor-Craft president Gilbert Magill was granted several patents in monopropellant, throttleable liquid rocket engines.

Currently, the company has contract to flight test prototype machine, with hopes for production orders.

During the Pinwheel demonstration, Magill also showed a wooden box 4 ft. 11 in. long, 16 in. wide and 21 in. deep which, he said, houses an even later one-man machine development which weighs less than 75 lb. dry.

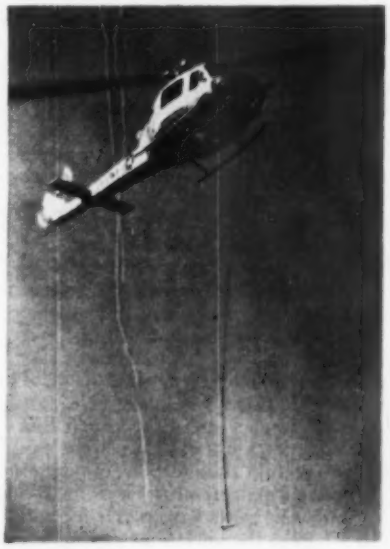
Speaking of the company's plans, Magill said he forsees production one-man helicopters of the extremely simple type his company has developed, priced in the range of $1,000.

Flying Atar Tested For French Officials

Bonn—First official test flight of the VTOL Flying Atar in the presence of French government representatives took place this week at Melun-Villaroche. This was announced by Snecma President Henri Debrueres during the Aviation Congress held at Duesseldorf.

Tufted XH-40 Tests Rotor Wash

Tuft tests with Bell XH-40 check effect of rotor wash on air currents. Helicopter is towing an airspeed indicator bird, which flies out of wash, checks effect of wash on air speed indication. Note tuft patterns in cockpit and tail rotor areas.



USAF, Industry Revise Spares Support Concept

By Claude Witze

Washington—Basic allocation of more funds for weapon systems and less for spares support will result from new provisioning policies now being worked out by the Air Force in cooperation with the aircraft industry.

According to Maj. Gen. Mark E. Bradley, Jr., Assistant Deputy Chief of Staff, Materiel, improvements already put into effect have reduced the cost of initial spares from 43.4% of the total aircraft program in Fiscal 1951 to 23.5% in Fiscal 1957. The General gives credit to recommendations and studies by the aircraft industry for making many economies possible. Key programs are:

• **Delayed Procurement Concept,** applied to high-cost, low-usage airframe items, officially became effective in January. Procurement and delivery of the spare item is deferred until a requirement exists or production has reached the point where a decision must be made to buy for stock.

• **Responsive Production Concept** to be introduced later this year will end the policy of ordering the full quantity of estimated initial spares. Only a portion of the initial spares will be ordered and material set aside for the balance.

USAF emphasizes that its Responsive Production Concept has no affiliation with the rules governing the mobilization program and will be a routine procedure. It is expected that the degree to which it is applied will depend upon the nature of the weapon system and the manufacturer's plant capabilities. It is assumed that some aircraft firms can control and promise delivery to USAF on a larger number of items than others.

North American Aviation, Inc., has made a study of the proposal to determine its effect on normal plant operations. According to Gen. Bradley, North American figures show that the program is feasible and could be applied to as many as 300 to 350 items in the case of a fighter aircraft. They would represent about 60% of the total cost of the initial spares requirement.

Responsive Production is expected to apply to the prime contractors and first-tier vendors but no lower on the subcontract structure. Emphasis will be placed upon high and middle-cost items. There will be some decrease in USAF's control of low-cost items—those costing less than $10—and larger stocks of these units will be set aside.

As explained by Gen. Bradley, fabrication, assembly and shipment of units for which material has been allocated will not be ordered until it is possible to make an accurate prediction of the initial spares requirement.

Application of System

Application of the new system, it is pointed out by USAF spokesmen, should work well with missiles and the more complex aircraft weapon systems now being manufactured. Usually, these weapons have to be provisioned before the Air Force has obtained any substantial operating experience. Delay in ordering spares will insure that when they are made they will be of the latest design and that they will not be left unused on the stock shelves.

The Delayed Procurement Concept already is in force on some weapon systems, including the Convair F-106, McDonnell F-101 and Lockheed F-104. Procurement of spare parts for initial support was curtailed beyond the first two production contracts.

Purpose of this approach is to obtain better consumption figures before starting full procurement.

To USAF procurement officials, the important result of the new system is that it will provide better support along with greater flexibility in the use of available funds. More effective management will result in fewer initial purchases, postponing the purchase of large quantities as long as possible.

Prior to Fiscal 1957, all spare parts were not funded out of the same USAF appropriation. Initial spares were paid for from the classification of aircraft and related procurement.

Follow-on spares were purchased with money from the operations and maintenance appropriation. Starting this year, all have been paid for from the aircraft and related procurement appropriation, a step that has provided the administrators with more flexibility in use of the funds along with economy.

The procedure is described by USAF spokesmen as one of "continuous provisioning" instead of "initial" and "follow-on" provisioning.

USAF has three other procedures designed to improve handling of spares:

• **Return of stocks** to the production line when extra supplies can be utilized in the finished weapon system. Last year, $18 million in spares was returned to manufacturers under this system. The policy is applicable to long-term contracts, such as the Lockheed T-33.

• **Analytical overhaul,** which applies mainly to engines and other recoverable components. After three-to-six-months of use, the items are taken apart and spares orders are adjusted according to the amount of wear that has developed. This insures an even flow of necessary spares and alerts the contractor to points where design improvement is called for.

• **Stockage of spares in kit form** cuts down on the number of requisitions of replacement parts. This eliminates thousands of items from the stock lists, repackaging and shipping expenses. It speeds repairs and increases the service life of components after overhaul. It is used in the aircraft instrument and accessory areas.

No B-52 Increase

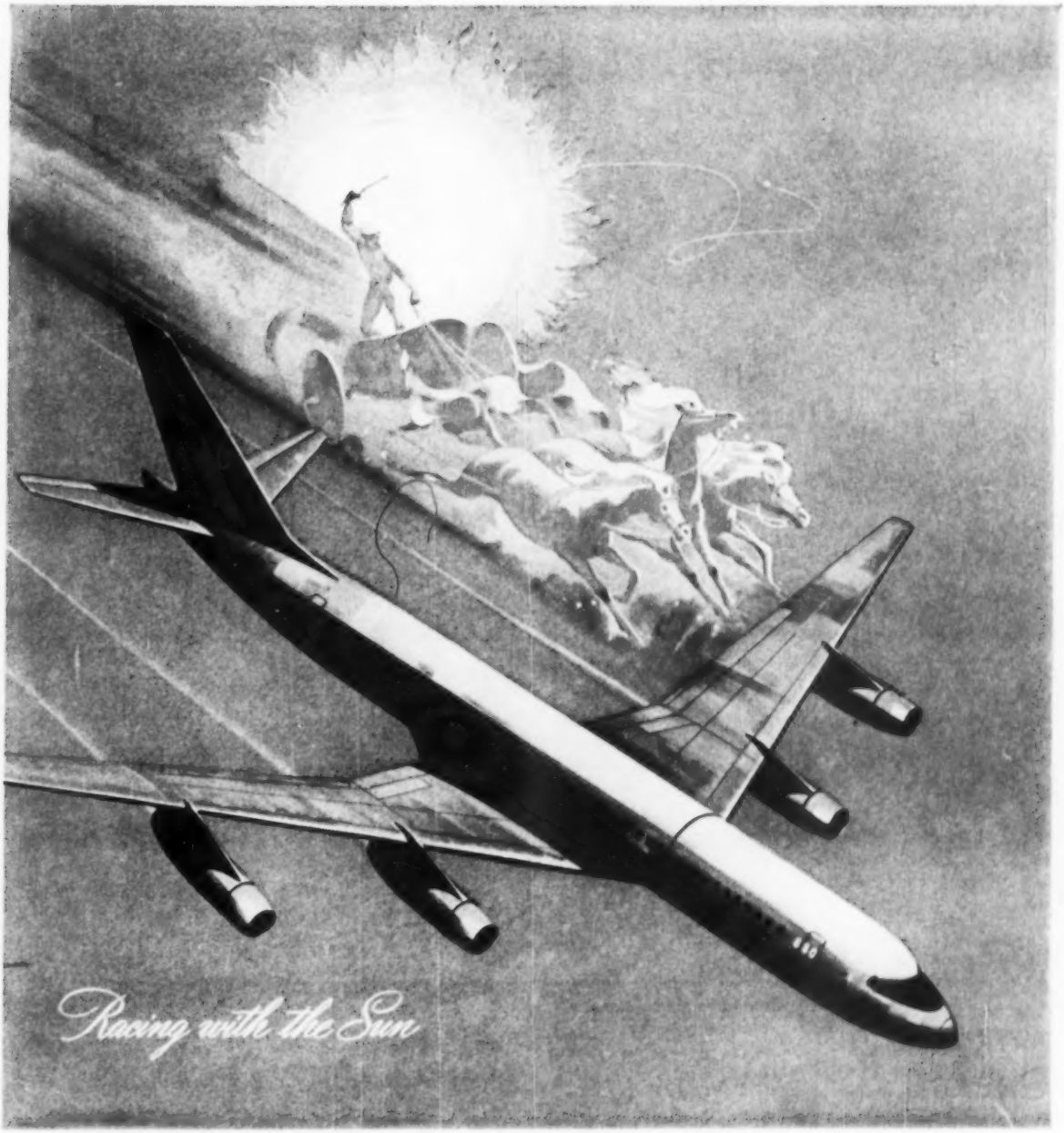
Washington—USAF announced late last week that it will hold production of the Boeing B-52 intercontinental jet bomber to the present rate of 15 a month instead of expanding it to the 20-a-month goal announced last year. Output of the Boeing KC-135 tanker also will be held to 15 a month when that figure is reached in about a year.

It was emphasized that the Boeing plant capacity will be retained at a level where output of 20 bombers a month will be possible if the decision should be reversed. Total of 603 B-52s has not been altered, but it will take an additional six months to reach that figure.

Congressional observers were not surprised at the decision. Some felt the slowdown was to be expected and that the significance of the schedule change was in the fact that USAF voluntarily announced the decision.

Infrared Proximity Warning

Proximity warning collision avoidance systems using infrared techniques will be proposed by four avionics manufacturers at Air Transport Assn. meeting in Washington, April 30, to May 2. Companies include: Aerojet-General, Farnsworth, Nevada Air Products and Raytheon. Spokesman says ATA has been deluged with inquiries and proposals for infrared proximity warning systems following Aviation Week's series on infrared which pointed out this challenging application (March 18, p. 94). Remainder of three-day meeting will include report by Bendix Radio on its new proximity warning/collision avoidance system program for the Air Force and an analysis by Boeing of the system requirements for its 707 jetliner. Organizations wishing to send representatives to the meeting should contact Frank C. White, ATA, Washington, D. C.



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Racing with the sun at 615 miles an hour, Convair's 880 Jet-Liner will cut your travel time in half! The only jet transport designed to operate from hundreds of existing airports, it will bring silent, vibrationless flight to travelers everywhere . . . big cities and small.

Convair's 880 Jet-Liner, powered by General Electric CJ-805 engines, will be delivered to leading airlines* for world-wide service beginning in 1959. In this new era of jet transportation, Convair's luxurious 880 Jet-Liner will be the world's fastest passenger plane—truly master of the skies!

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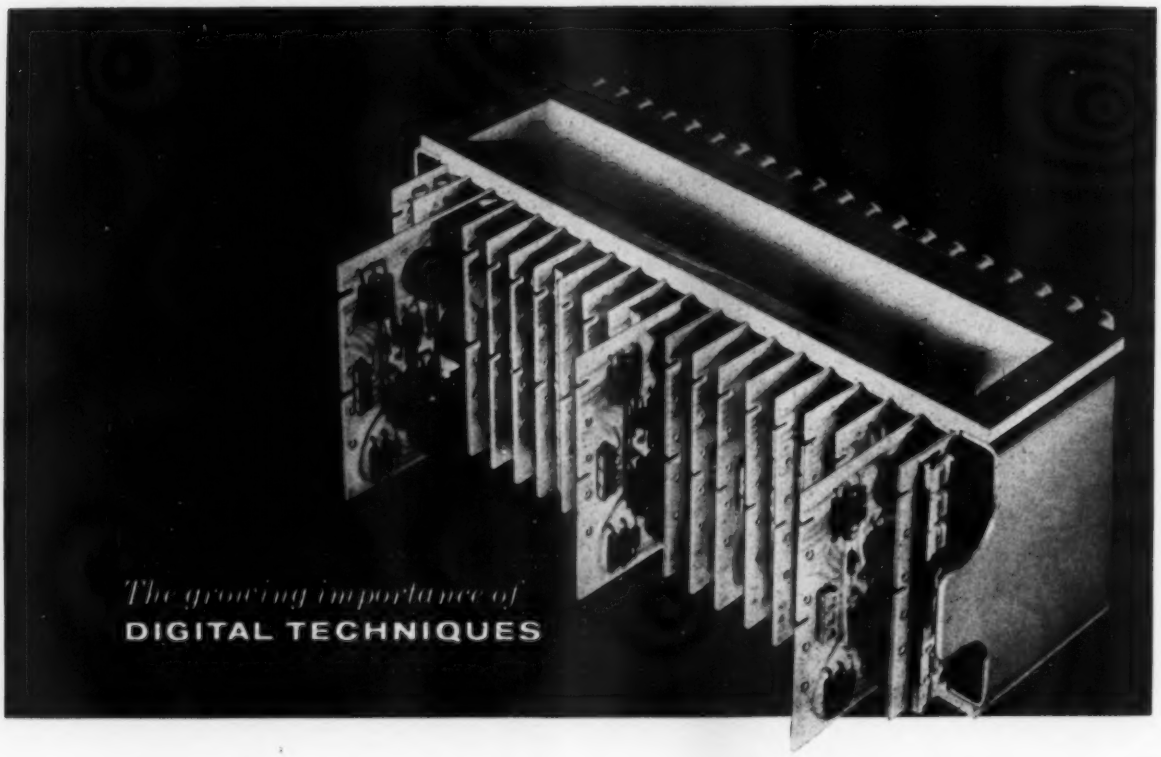
*AMONG AIRLINES TO FIRST OFFER CONVAIR 880 JET-LINER SERVICE WILL BE TWA • Delta • TRANSCONTINENTAL S.A. (Argentina)



As recently as ten years ago it was just becoming evident that digital techniques in electronics were destined to create a new and rapidly growing field. Today, incorporated in electronic computers and other equipment, they constitute one of the most significant developments in scientific computation, in electronic data processing for business and industry, and in electronic control systems for the military. In the near future they are expected to become a major new factor in industrial process control systems.

The digital computer for scientific computation is becoming commonplace in research and development laboratories. Such machines range from small specialized units costing a few thousand dollars, to large general purpose computers costing over a million dollars. One of these large computers is a part of the Ramo-Wooldridge Computing Center, and a second such unit will be installed the latter part of this year. The digital computer has not only lightened the computation load for scientists and engineers, but has made possible many calculations which previously were impracticable. Such computers have played a major role in the modern systems engineering approach to complex problems.

Electronic data processing for business and industry is now well under way, based on earlier developments in electronic computers. Data processors have much in common with computers, including the utilization of digital techniques. In this field, teams of Ramo-Wooldridge specialists are providing consulting services to a variety of clients on the application of data processing equipment to their problems.

The use of digital techniques in military control systems is an accomplished fact. Modern interceptor aircraft, for example, use digital fire control systems. A number of Ramo-Wooldridge scientists and engineers have pioneered in this field, and the photograph above shows a part of an R-W-developed airborne digital computer.

These, then, are some of the aspects of the rapid growth which is taking place in the field of digital techniques. Scientists and engineers with experience in this field are invited to explore openings at The Ramo-Wooldridge Corporation in:

Automation and Data Processing
Digital Computers and Control Systems
Airborne Electronic and Control Systems
Guided Missile Research and Development
Electronic Instrumentation and Test Equipment
Communication Systems

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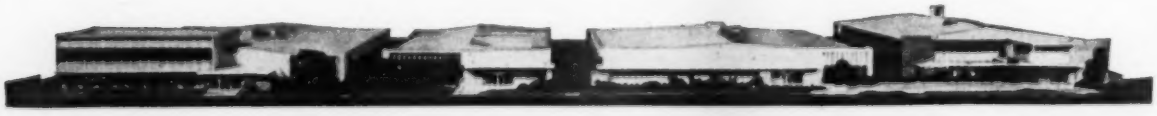


Vertol Unveils VTOL Model 76

Tilt-wing Vertol 76 has reached test stage and is expected to be flying in near future. First pictures of the VTOL research aircraft, powered by Lycoming T-53 turbine engine, show how wing and two counter-revolving rotor-propellers tilt through 90-degree arc. Hovering regime yaw and pitch are controlled by two ducted fans in tail section. Manufacturer says plane, developed with Army funds in cooperation with ONR, is designed for STOL also. Wing can be rotated to any position depending on runway length and load.

Transatlantic Air Travel Rise Predicted

Survey estimates peak of 440,000 passengers for summer, an increase of 15%; schedule expanded.

New York—Transatlantic airlines will carry about 440,000 passengers on their scheduled flights this summer, an AVIATION WEEK survey indicates.

After a relatively slow start early this year, bookings have picked up to where an increase of about 15% can be expected over the record June-through-September total last year of 380,265 passengers (AW Feb. 18, p. 38). Last summer's total itself represented an increase of 16% over the 1955 season.

With expanded fleets and a new fare structure over the North Atlantic, U.S. and foreign flag carriers are offering a peak total of 297 weekly flights in each direction this year. The total is 13% greater than last summer's, and many of the flights are scheduled in larger aircraft, raising the number of seats for sale.

Seats available this season should total about 671,250, up from 559,381 in both directions during the same period of 1956.

Mixed-class configuration dominates the transatlantic scheduling this summer. Mixed flights total 155 weekly at the peak, compared with 125 all-tourist, 17 first-class, and 10 all de luxe flights.

The de luxe fare class is new this year. International Air Transport Assn. decided in 1955 to reduce standard first-class fares, add a $50 one-way surcharge for the de luxe service. In standard first-class configuration, seats are limited to a 42-in. maximum pitch. Fully reclining "sleeper" seats now are features of the de luxe class.

Some reconfiguration has been made necessary by the change. For example, Pan American World Airways shuffled its Stratocruiser configurations, blocking the seats on its President schedules so they are no longer fully reclining. President is now a standard first-class airplane, while the President Special, with two flights a week, will carry all de luxe class passengers.

Other changes in the 1957 fare picture include:

- **Elimination** of the off-season fare, replaced by the year-round excursion fare with 17-day limit.
- **Continuation** of family plan, but not in conjunction with excursion fare.
- **Extension** of new immigrant fare through June 30.

As far as the effect of the excursion fare on summer business is concerned, carriers' reports are mixed. Consensus appears to be that it hasn't been a big factor so far, may become one later in the season because many new tours are pegged to the 17-day plan.

KLM Royal Dutch Airlines says the excursion plan is "popular," finds it too early to be more specific. British Overseas Airways Corp. reports little business in excursion sales. Scandinavian Airlines System, proponent of a three-week time limit instead of two, says the present plan "hasn't given us too much business."

Most carriers found their long-range bookings relatively lower during the first few weeks of 1957. But after a pause, bookings picked up again for later in the season and are now expected to continue that way.

Short-range bookings had remained heavy during period of hesitancy:

- **KLM's** bookings a month ago for April and May were higher than at the same 1956 date by 30% in the tourist category, 9% in first class. But bookings for June and July then were only 5% higher in tourist business, no higher in first class than as of March, 1956.
- **Air France** found a "hesitancy" in January and February which has now passed.
- **BOAC's** bookings for this season were late-starting, are now 20% over last year.

Many travelers considering European vacations this year apparently waited to see if the political situation would

Transatlantic Flights

Summer 1957 Weekly Schedules (Peak)
(Each Direction)

	T	F	M	D	Summer 1957 Total Weekly	Summer 1956 Total Weekly
Air France	7		16	1	24	20
BOAC	7		10	7	24	19
CPA			4		4	0
El Al	3				3	3
Iberia	2				2	2
KLM	14	7	3		24	21
LAI			7		7	7
Loftleidir	7				7	6
Lufthansa			9		9	11
Pan American	21	9	45	2	77	75
Sabena			14		14	10
SAS	17		9		26	21
Swissair		1	8		9	7
TCA			12		12	10
TWA	37		18		55	50

T—tourist F—first class M—mixed class D—de luxe

worsen, decided it wouldn't, and went ahead with their plans.

• **Sabena** Belgian World Airways will offer 14 flights, all DC-7Cs with 59 tourist, 10 standard first, and four de luxe seats. Last year Sabena flew 10 peak schedules in mixed DC-6Bs. Sabena is pushing Paris-Brussels helicopter service, finds its Russian tours popular.

• **SAS** increased its peak schedules by five for a total of 26. From New York, the airline will fly 17 all-tourist DC-6B flights carrying 69 seats, nine DC-7C mixed schedules with 34 tourist and 12 first-class seats plus eight berths. SAS's Los Angeles-Copenhagen Polar route schedules this year will total seven, all of them DC-7Cs in mixed configuration.

• **Swissair** will schedule nine peak flights, up from seven last summer. One of them will be in DC-6B equipment, the others in the airline's new DC-7Cs. All flights will be mixed except one weekly all first-class schedule. Carrier will fly to Switzerland via Cologne/Bonn instead of Frankfurt this year.

• **Trans-Canada Airlines** will offer 12 Super G flights with 54 tourist, four standard first-class, and seven de luxe seats. Total increase two.

• **TWA** will schedule 55 flights each way at the peak, an increase of five over last summer. No all first-class flights will be scheduled. Eighteen mixed Super G flights will seat 15 tourists, 15 standard first-class passengers, eight de luxe passengers, and will provide eight berths. Sixty-seat all-tourist Constellations will make up the rest of the schedules until introduction of the 1649As in July and August. "Jetstream" flights will be all-tourist, seating 74.

New equipment on the Atlantic this summer will include the Douglas DC-7C, appearing in quantity on several airlines' schedules, and the Lockheed 1649A Super Star Constellation. The 1649A will go into Trans World Airlines service in June as the "Jetstream," and into Air France service in August as the "Super Starliner."

Most airlines seem to be developing their existing package tours rather than adding many new ones this year. Trend is toward weeding out less profitable tours, strengthening and expanding the money-makers.

Individual plans of the North Atlantic carriers this summer:

• **Air France** will offer a peak total of 24 flights each way, 16 of the mixed, seven all-tourist, one all de luxe. Five of the mixed schedules will be new through flights from the U.S. continuing on from Paris to the Near East. Two of the 24 flights will originate in Chicago and fly via Montreal.

• **BOAC** will offer 24 flights, with seven all de luxe Stratocruiser schedules. Other schedules will be seven all-tourist DC-7C flights, ten mixed DC-7C flights. Two of the mixed flights will serve San Francisco this year.

• **Canadian Pacific Airlines** will make its debut this year in Montreal–Lisbon service. Four weekly DC-6B roundtrips will be offered on the airline's new route, all of them mixed flights. CPA also flies a Polar route from Vancouver to Amsterdam.

• **El Al Israel Airlines** will offer three Constellation flights a week, same number as last year, again all-tourist. Airline hopes to have Britannia service by the last week in July, but is waiting to see what the Bristol workers' strike will mean in delivery dates. U.S. State Department's travel ban to the Mid East hurt El Al's bookings, especially for the Passover season which normally provides the airline with considerable business. Ban was lifted April 1, however, and El Al has experienced a strong increase in business. The carrier's Europe-Israel and westbound transatlantic business good all along.

• **Iberia** will schedule three Super G flights, same as last year. The Spanish carrier expects good business from IATA's General Meeting in Madrid this September, and from a travel agents' meeting there in October.

• **KLM** will offer 24 flights, seven of them in DC-7C equipment with mixed first-class and de luxe configuration. Other flights will be 11 Super G all-tourist schedules, three mixed Super G flights, and three all-tourist Constellation flights. KLM expects to fly 100 transatlantic charters this summer.

KLM doesn't believe in mixing first-class and tourist passengers in the same airplane, holding that service is better and crew duties easier on single-class flights. The airline is making an exception this summer with three mixed flights serving Scotland and Ireland, in order to provide enough frequencies for each class of traveler for the summer season. When equipment permits, however, KLM wants to go back to the single-class schedules.

• **Linee Aeree Italiane** will schedule seven DC-6 and DC-6B mixed flights this summer, same total as last year. LAI is awaiting results of a reorganization before expanding its service.

• **Loftleidir** added a DC-4 all-tourist schedule this summer for a total of seven. The airline is buying Lockheed Electras for the Atlantic run, expects delivery in 1959.

• **Lufthansa** cut its North Atlantic schedules this year from 11 to nine, all of them mixed tourist and de luxe Super G flights. Reduction resulted from transfer of some equipment to new routes to South America and the Middle East. The German carrier has ordered 1649As, with delivery beginning in late fall.

• **Pan American** increased its peak schedules from 75 to 77 each way. DC-7C, Stratocruiser and DC-6B seats will split 68% tourist, 32% first-class and de luxe. As of April 1, Pan American had booked 10,405 tourist passengers for June, an 11.1% increase over last year's bookings.

CAB Issues Report On Canyon Collision

Washington—Civil Aeronautics Board issued its report last week on the mid-air collision between a United Air Lines DC-7 and a Trans World Airlines Constellation over Grand Canyon last June 30 listing probable cause as failure of the pilots to see one another in time to avoid the accident. Reason for the failure was not determined, but the Board listed these possibilities:

• **Intervening clouds** reducing time for visual separation.

• **Cockpit visibility** limitations.

• **Preoccupation with cockpit** duties.

• **Preoccupation with matters** unrelated to cockpit duties such as attempting to provide passengers with a more scenic view of the Grand Canyon area.

• **Physiological limits to human vision** reducing the time opportunity to see and avoid the other aircraft.

• **Insufficiency of en route air traffic** advisory information due to inadequacy of facilities and lack of personnel.

From an analysis of the wreckage, CAB determined that the initial impact occurred with the DC-7 moving from right to left relative to the Constellation.

It appears, the Board said, that the first contact involved the center fin leading edge of the Constellation and the left aileron tip of the DC-7. Immediately afterwards, the lower surface of the DC-7 left wing struck the upper aft fuselage of the Constellation with disintegrating force.

The Board said this force caused complete destruction of the aft fuselage and destroyed the left wing outer panel. As this occurred and the aircraft continued to pass laterally, the left fin leading edge of the Constellation and the left wing tip of the DC-7 made contact, tearing off pieces of both. At the same time, the Board said, the DC-7 No. 1 propeller inflicted a series of cuts in the area of the aft baggage compartment of the Constellation.

From the extent of damage and the locations of various parts on the ground, the collision ripped open the fuselage of the Constellation from just forward of its tail to near the main cabin door.

The CAB said this accident apparently occurred in visual flight weather conditions and that there is no reason to believe the aircraft were not being operated in accordance with cloud separation criteria of visual flight rules.

Curtis Asks CAA, CAB Reorganization

By Katherine Johnsen

Washington—Basic reorganization of the functions of Civil Aeronautics Administration and Civil Aeronautics Board will be considered within the near future by the House and Senate Commerce Committees.

Testifying before the House Commerce Committee last week, Edward P. Curtis, special presidential assistant for aviation facilities planning, declared that the present governmental system for civil aviation is "extraordinarily complex and not very effective" and that "it is obvious the present system just doesn't work well."

Curtis Plan

Hearings are expected to begin shortly after the submission of recommendations for a board reorganization by Curtis. These are due the first week of May.

Urging passage of legislation to create a three-man Airways Modernization Board (AW Apr. 15, p. 29), Curtis emphasized that a more basic re-alignment of government organization for aviation should be a long-term proposition. He said:

"The functions which the Board will perform are entirely in consonance with the considerations being given to a broader change in federal government organization in aviation matters. In my final report, I intend to cover the broader plan.

"However, it is now clear that much more thorough examination needs to be undertaken in order to achieve a durable permanent organization. To recommend such in final form too quickly might result in improvisations which would complicate or delay the expected action necessary to accommodate the civil and military needs of aviation in the future."

Congressional Skepticism

Curtis' proposal for the Airways Modernization Board will have to buck congressional skepticism over the creation of additional government agencies. Rep. J. Arthur Younger (R., Calif.) said at a session of the House Commerce Committee that, "It is the old American system of setting up another committee or board and thinking you have solved the problem."

Members of the proposed board would be the Secretary of Commerce, the Secretary of Defense and a third member who would be appointed by the President and not connected with any other agency of government.

Decisions would be made by majority vote, but some House Commerce Committee members expressed doubt that any one except the President himself could over-ride a member of the Cabinet on matters affecting his department.

Meanwhile, the Air Line Pilots Assn. protested military encroachment of the airways to both House and Senate Commerce Committees. An ALPA report by Mel Logan, west coast regional air safety chairman, complained:

"The military is objecting to the establishing of every airway in the CAA long-range program in this region. Serving the public interest, in the minds of the military members of the airspace subcommittee, is serving the convenience of every branch of the military, before releasing any part of our diminishing air space for public use.

"A good look at the map today shows an unrealistic pattern of prohibited, restricted, and caution areas plus the attitude of the military that every open area is a training area or planned training or potential training area. To further complicate this picture is the failure of the different armed services to share these training areas between themselves.

"The coordination and cooperation of our military units in time of war is a must and certainly would be ideal training in peacetime. We are at the point where more joint use of the air space is mandatory."

Developments at a House Commerce briefing session with CAB Chairman James Durfee were:

- **Durfee said the CAB** will consider a proposal by Rep. Walter Rogers (D., Tex.) that airlines be required to pay a "bonus" to passengers with reservations who cannot be accommodated on their flight. Rogers said that "if the airlines are going to impose fines for no-show passengers, it ought to work the other way, too." Durfee agreed that "some method should be devised to take care of the passengers."
- **CAB announced** that it will request legislation this session authorizing government-guaranteed loans for local service airlines for equipment financing.
- **Committee chairman** Rep. Oren Harris (D., Ark.) said his committee will take steps to transfer military traffic, increasingly being handled by USAF's Military Air Transport Service, to commercial carriers.

Durfee agreed and said the portion of military passenger traffic handled by commercial lines dropped from 37% in 1951 to 18% in 1956 and that cargo and mail traffic dropped from 31% to 9% over the five-year period.

CAB Opposes IATA Fare Plan

Washington—Civil Aeronautics Board opposition to the proposed passenger fare increases over the North Atlantic may mean a reduction in fares instead.

After the CAB voiced its opposition to the increase, a spokesman for the International Air Transport Assn. said transatlantic airline operators had agreed to follow a CAB suggestion to increase seating densities on their aircraft. Such a move, Board said, would permit a reduction in fares.

John Brancker, IATA traffic director, said the higher density seating arrangement is expected to go into effect by April 1, 1958.

5% Increase

IATA had urged governments of all airlines flying the North Atlantic to approve the proposed fare increase in the form of a 5% surcharge as an emergency measure to meet new increases in operating costs. The increase was to go into effect May 1 if the proposal received approval of all interested governments. The only opposition voiced was that of the CAB.

The Board announced it would defer action until April 25 so as to give any interested parties an opportunity to present arguments in support of, or in opposition to, the proposed disapproval of the request for fare increases. It added, however, that under any circumstances it would find it difficult to justify an increase based upon seating densities and standards of service which the Board has repeatedly said it considers economically unsound.

Previous Order

At the same time, the CAB referred to its order of last August in which the Board said proper development of international air transportation requires low fare service in order to make maximum use of the carrying capacity of modern transport aircraft (AW Aug. 27, p. 41).

The Board also said it is convinced that seating policies presently employed in tourist service do not reflect the maximum carrying capacity. The most fundamental requirement of a proper and economically constructed fare structure, the CAB said, is the pricing of the low-fare service on seating configuration designed to efficiently utilize the aircraft capacity.

The Board added that it believes proper maximum seating density re-

quirements would permit a reduction in tourist fares of about 10% without disturbing the current overall revenue position of the carriers concerned.

In the absence of such adjustments, the CAB said, the traveling public is deprived of lower fares that are both feasible economically and desirable in the interests of air transportation.

In deferring action on the proposed increase, the Board also expressed opposition to the manner in which the proposal was initiated. It said the agreement was initiated by IATA as an organization as opposed to the usual practice whereby a mail vote is requested by one or more carriers.

The Board said in its opinion that the initiative in the formulation of mail and rate adjustments should remain with the air carriers at IATA. It added that initiation of agreements by the IATA Secretariat appears unsound as a matter of policy and represents a type of price-fixing procedure which the board considers objectionable.

Idlewild Will Admit Caravelle

New York—Turbojet transports got a foot in the hitherto tightly closed door to Idlewild Airport last week when the Port of New York Authority laid out a welcome mat for the twin-jet Caravelle.

CAA announced that the Caravelle also will be permitted into Washington National Airport, so the French transport will be the first jetliner to operate from either of the two fields.

Port Authority's exact method of judging a jetliner's acceptability still remained vague, but the agency said it had sent an acoustical consultant team to Paris and it found the Sud Aviation aircraft no noisier externally than a DC-6 or Super Constellation.

PNYA had said (AW Mar. 4, p. 45) that Sud Aviation had requested permission to come into Idlewild, but that more data on the Caravelle's noise characteristics was needed.

The Port Authority, which has barred from the airports it operates the Boeing 707 prototype, Comet IA and II and any other jet that might jar its sensitive community relations ear, will not talk about decibels or any other objective standards for accepting or refusing a jet transport. It won't say whether it studied the Boeing 707 as it did the Caravelle. It won't say specifically how the 707 violates its requirements.

Refers Question

All the agency will say on the subject is "we must refer any questions on the noise characteristics of the Boeing 707 to Boeing."

The agency won't comment, either, on the cancellation by Executive Director Austin J. Tobin of a scheduled speech to the Society of Automotive Engineers National Aeronautic Meeting. Subject: Air Operations Problems in the Vicinity of Metropolitan Areas. Tobin, as a Port Authority spokesman, had enunciated frequently the anti-noise policy on jets.

Port Authority's reluctance to be more definite about noise level requirements may be motivated by concern for the future. If the Port Authority found it necessary to ease jets in later at noise levels not too different from present levels, any hard and fast definition of "acceptable" noise characteristics could be embarrassing.

Boeing's reaction to the news about Caravelle:

"We're very, very happy to hear about it—the more good publicity for jet transports, the better for the industry."

Boeing says some members of a Port Authority party took a few sound measurements during recent 707 tests at Seattle-Tacoma International Airport, but that a complete survey of the type done in Paris was not planned nor accomplished on the Boeing plane.

707 Noise Level

Bolt, Beranek and Newman, Inc., the consulting firm who studied the Caravelle for the Port Authority, have placed the Boeing 707 takeoff noise level at 130 decibels maximum overall sound pressure at 900 ft. (AW Sept. 3, p. 50).

Boeing said its suppressor work was going well and four prototype units would be flying in June.

Aviation Week asked a spokesman for the City of New York whether the Port Authority's stand on jet transports might jeopardize the city's future position as a leader in air transportation services. The spokesman expressed confidence that engineers would develop a silencer to solve the noise problem.

New York City has taken no direct or indirect action to change the Port Authority's position on jets as operator of the city-owned metropolitan fields, the spokesman said.

Sud Aviation reacted happily to the Port Authority decision and plans to bill the Caravelle as "the aircraft of tomorrow for the runways of today." The demonstration plane, which is the second Caravelle prototype, was scheduled to leave Dakar for Brazil last week on its tour of South and North America. On May 2, schedule calls for a Caracas-Miami-New York flight.

The airplane is in a 54-passenger configuration with plush interior.

C-W Offers Airlines Olympus Jet Engine

Curtiss-Wright Corp., Wood-Ridge, N. J., will offer its version of the 16,000 lb. thrust Bristol BOL.6 as a powerplant for civil transports.

Curtiss-Wright said that the new two-spool turbojet, which it designates the Series 550, provides the necessary thrust for all-weather operation of commercial transports out of present airports. It will do this at better thrust-to-weight ratios and lower fuel consumption and noise levels than competing turbojets, Curtiss-Wright spokesmen claim.

Relatively low turbine inlet temperatures are being used for better engine reliability and longer life.

Because of these lower turbine inlet temperatures, it is possible that the Series 550 engine is a debated version of the BOL.6 which has been type tested (the British parallel to U.S. 150-hr. qualification) at 16,000 lb. thrust.

For five years C-W has been working on the J67, a scaled-up 12,000 lb. thrust Americanized version of an earlier Olympus model, the 9,000 lb. thrust BOL.1. These efforts were under USAF sponsorship and it was hoped that the J67 would follow the success of the J65, the C-W import which the American engine-builder patterned after the British Sapphire turbojet. However, the pace of the J67 development program was not competitive with the Pratt & Whitney J75 and the J67 has found its use limited to the Republic XF-103.

As part of its bid for the commercial jet market, C-W plans to demonstrate the series 550 publicly next month at its Quehanna, Pa., manufacturing and test area.

C-W will continue its "engineering assistance" agreements with Armstrong Siddeley in Great Britain and Daimler-Benz in Germany, according to C-W president Roy T. Hurley. In connection with Curtiss-Wright, Studebaker-Packard and Daimler-Benz agreement in the automotive field, Hurley said that C-W also expects to announce a joint C-W and Daimler-Benz project to cooperate in the field of jet engines.

The Wright-Bristol agreement also covers a number of other gas turbine engines.

British sources say Lockheed Aircraft Corp. is planning to evaluate the Bristol Orpheus engine as a possible powerplant for its entry in the USAF competition for a 10-passenger military and business executive jet transport. Presumably other entrants in this competition will also take a look at the Bristol engine and this could be linked with the Curtiss-Wright agreement.

X Pattern Breeds Efficient Schedule

By Glenn Garrison

Vancouver, B. C.—Flying a 31,000-mile international route pattern with seven airplanes calls for something special in the way of utilization. Canadian Pacific Airlines, with criss-crossing great circle routes that span a good part of the globe, ranks high among the world's airlines in unduplicated route-miles if not in route-miles flown.

Last year CPA carried 272,685 domestic and international passengers some 264,366,231 revenue-miles. With its eye on the long-haul side of its business, the airline has big plans for the future.

A $20 million expansion program now under way includes purchase of five Bristol Britannia turboprops, a new hangar and other facilities at its Vancouver base, and an increase in personnel. Eight more DC-6Bs of an order of 11 are still to be delivered. And the airline is about to open a new route from Toronto and Montreal across the Atlantic to Lisbon.

But for the present CPA must serve its 29,718 miles of international routes from Vancouver to the Orient, Australia, South America and Europe with a fleet of seven DC-6B's. Inauguration in June of Toronto-Montreal-Lisbon service will raise the total to about 31,000 miles, and it will be September before more than seven planes are flying the entire network.

Maximum Utilization

Two factors particularly favor maximum utilization of CPA's long range planes:

- **X-shaped pattern** formed by the airline's longest routes, with its main base and maintenance headquarters at the center of the X.
- **Scheduling flexibility** provided by balanced seasonal characteristics of the route segments.

One stroke of the route pattern's X shape stretches from Australia via New Zealand, Fiji and Hawaii to Vancouver and on across a polar path to Amsterdam. The other stroke runs from Buenos Aires via Lima and Mexico City to Vancouver and on across the Pacific to Tokyo and Hong Kong. A shorter route breaks off the X at Mexico City and runs to Toronto. The new Lisbon service will extend this segment to Montreal and on over the North Atlantic.

CPA gets about 10.5 hrs. a day utilization from its DC-6Bs now, according to C. G. Rose, maintenance planner for the airline. Aircraft are scheduled so they end up at the Vancouver maintenance base near the 100-hour mark for inspection, C. G. Rose told AVIATION WEEK.

Here's how the airline's planes can cover the major route segments and arrive at Vancouver at the right time for maintenance:

- **When Lisbon** service begins, one DC-6B can fly from Vancouver to Mexico City, make two round trips between Mexico City and Lisbon, then return to Vancouver with 115 hours of flight time logged.
- **Another plane** will be routed Vancouver-Mexico City, make two round trips between Buenos Aires and Mexico City, then return to Vancouver at the 85-hour mark. The above two aircraft thus have provided two complete round trips between Europe and Vancouver and South America and Vancouver, as well as two round trips between Mexico City and both Europe and South America.
- **A third** DC-6B can make two round trips between Vancouver and Hong Kong, arriving at its home base with 104 hours of flight time.
- **Fourth plane** will fly from Vancouver to Sydney, return to Vancouver, then make a round trip over the polar route to Amsterdam and back. Time: 103 hours.

The Mexico City junction has the effect of increasing frequencies without adding aircraft. Thus a flight out of Vancouver carrying Hong Kong-originating passengers to Buenos Aires will pick up passengers who came in to Mexico City on the airliner from Lisbon.

Above scheduling, which accounts for only part of CPA's fleet, illustrates the extreme flexibility provided by the route pattern itself. Another big advantage is the balanced seasonal demand of the airline's routes.

Seasonal Schedules

From Vancouver, CPA now operates two weekly round trips to Hong Kong, two to Buenos Aires, two to Amsterdam, four to Honolulu, one to Sydney. In addition, there are four weekly round trips between Mexico City and Toronto. When Lisbon service is inaugurated May 30, three Honolulu schedules will be canceled, two Mexico City-Toronto flights will be dropped, two Amsterdam flights will be added, and two Mexico City-Lisbon flights will be scheduled.

Winter is CPA's best season for Honolulu business, which tapers off during the warmer months. Polar route business to Amsterdam, on the other hand, is better in the summer. Therefore, pulling off Honolulu schedules and adding polar flights keeps the airplanes where the traffic warrants. Similarly, traffic between Toronto and Mexico hits a peak during the winter, so the two schedules taken off that run in May won't cost much business during the slacker summer season between Canada and Mexico. And, happily, CPA can expect its best Toronto and

CPA'S INTERNATIONAL ROUTES span 31,000 miles, with handy crossroads at Vancouver.

FIVE BRISTOL BRITANNIAS have been ordered by CPA for its long-range routes.

Montreal to Europe business during the summer, when its new Lisbon flights begin.

As one-a-month deliveries of the DC-6Bs start in May, the airline will begin pulling three present planes out of service for overhaul at the rate of one a month. Thus, through August the effective fleet total will remain at seven and there'll be the new route to serve. But because of the seasonal situation, the pinch wouldn't be felt until fall, and by then the fleet will be bigger.

Besides its international runs, CPA operates 9,663 miles of domestic routes with a fleet of 14 DC-3s, eight C-46s, five Convair 240s, two Otters, one DC-4 and two Cansos—converted Catalina flying boats.

Unusual Situation

The airline's situation is unusual in two further respects, one favorable and one something of a handicap:

- **As a wholly-owned** subsidiary of Canadian Pacific Railroad, the airline enjoys a highly advantageous financial position. For one thing it utilizes facilities and services of the parent company's world-wide organization.
- **As a potential competitor** of government-owned Trans-Canada Air Lines, CPA is restricted by an official policy which keeps it off TCA transcontinental and overseas routes.

Of CPA's directors, only President G. W. G. McConachie and Executive Vice President R. W. Ryan are not also directors of the railroad corporation. When the airline needs money for equipment, it can go to the railroad and borrow it, which of course is a much less painful way to find capital than most airlines must use. The railroad, in fact, administers CPA's purchasing department, making possible a variety of economies for the airline. Many supply items become available to CPA at big savings—for example, airplane carpeting manufactured by a CPR subsidiary.

The railroad's public relations people, as another example, are assigned to subsidiaries such as CPA.

Canadian Pacific Railroad sales offices all over the world are tied in with the airline, and in many cases the parent corporation's three transportation services—sea, air and rail—are sold in combination.

Before World War II, Canadian Pacific operated a fleet of ships across the Pacific, all of which were sunk during the war. McConachie went to CPR's board of directors and convinced them that replacing the ships with airplanes would make better long-range economic sense even if there were losses to begin with. First CPA transpacific services were subsequently started with four Canadair 4s (DC-6s with Merlin engines).

Unfavored Position

The airline's relatively unfavored position with the Canadian government was highlighted during the moves which led to award of its new route to Lisbon. According to some reports, the government gave CPA the route only to eliminate an election issue. In so doing, the Minister of Transportation reviewed government policy regarding the airlines' European operations: ". . . Trans Canada Air Lines is the Canadian air carrier designated by the government to operate transatlantic service to European points. . . . CPA has been designated . . . to operate international scheduled air services from Montreal to Lisbon and also to Madrid. . . . The government has reaffirmed its policy that TCA is and is to be the Canadian air carrier for service to other European points not at present served by a Canadian air carrier. . . ."

If CPA's Lisbon/Madrid service were extended to Rome, it would link handily with the carrier's Polar route to Amsterdam and maintain the flexible route pattern.

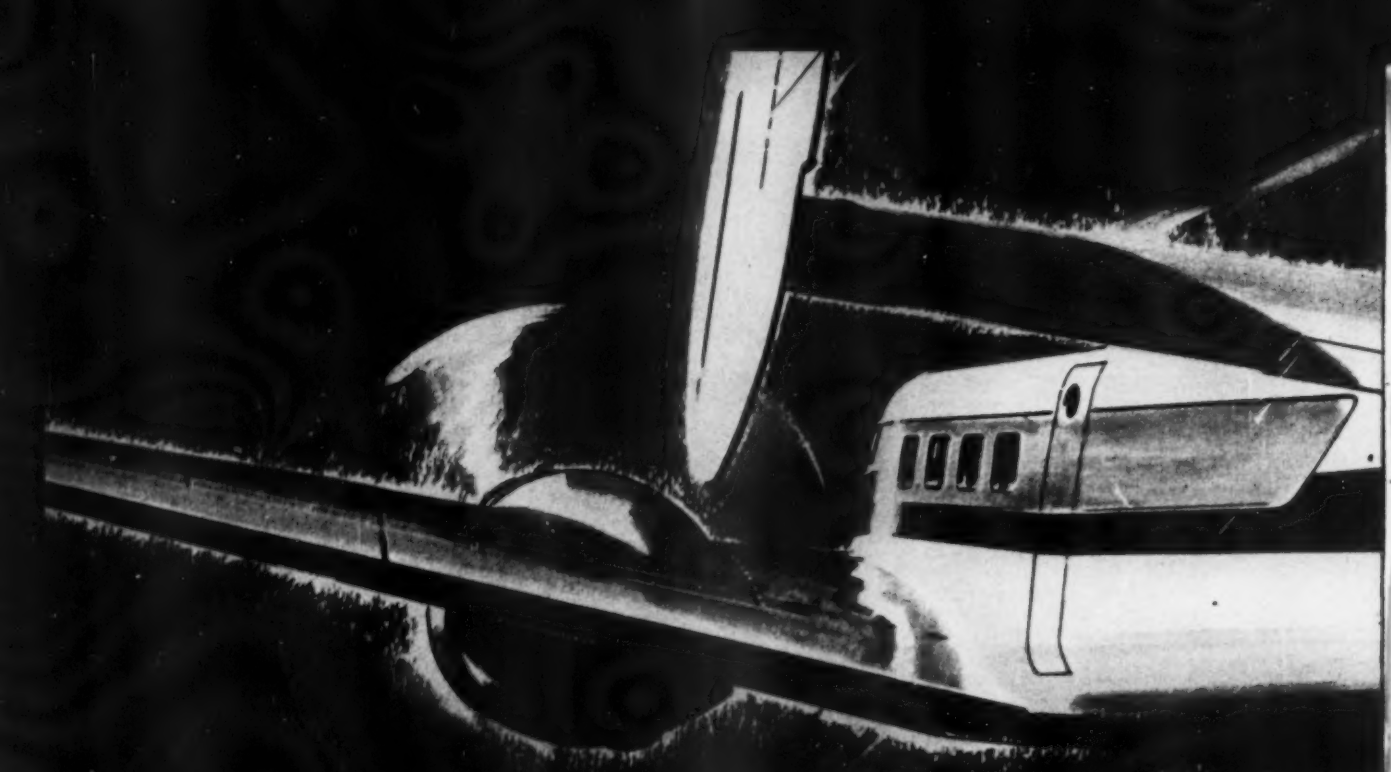
McConachie told AVIATION WEEK, however, that his airline has no intention of going to Rome—"that's TCA's." He also said there are no present prospects of a transcontinental route because he foresees no change in the government's position.

Expects Gross Increase

CPA's president feels the company has just "scratched the surface" in its development. He expects to do a gross business of $60 million in 1961, compared with a 1956 gross of "close to $30 million."

CPA's actual operating figures are not made public as such, being part of

C-46 modification is accomplished by CPA in its Vancouver maintenance headquarters.



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the parent corporation's operation.

McConachie was aboard a Britannia that lost an engine en route from Vancouver to Honolulu a few weeks ago and turned back to San Francisco. This didn't worry CPA's president, although the airline has five of the Bristol turboprops on order.

The incident "really sold me on the aircraft," McConachie said, adding that the plane's performance after an oil leak shut down one engine was "fantastic."

The Britannia, McConachie contends, will do anything a turbojet will do "only slower and cheaper." CPA has not ordered jets, but is "sitting and waiting—we're going to ride this panic out." He feels that CPA will suffer tough competition for a year or so against the jetliners, but can still order them in time for 1960 delivery when other airlines have gotten the bugs out of them.

"We've never bought an airplane that wasn't flying," McConachie says. He includes the Boeing 707 in the nonflying category because production models will differ from the prototype. CPA was ready to accept delivery of Comets for Pacific service just before the British jets were grounded.

Reciprocal Rights

The CPA official feels strongly that Canada and the U.S. should be much freer in granting reciprocal landing rights in their respective countries. The governments should "act like civilized people" and stop "all this poppycock" of stopping people at their borders, according to McConachie.

Examples of transborder routes CPA might consider profitable if rights were granted are Vancouver-Miami, Toronto to Los Angeles or San Francisco, Vancouver-Chicago, Toronto or Windsor to Honolulu, McConachie said.

McConachie raised a few eyebrows last year with a statement that he was "seriously considering" linking Australia and New Zealand with Europe via Argentina and the Antarctic ice cap.

He maintains that there's "nothing to it" operationally in flying such a route, but doubts that bilateral agreements could be achieved to make such service possible.

CPA's load factor on its international routes averages about 50%, the airline's president reports, and would be about 75% but for the addition of new routes. Polar route load factor is about 75% now, McConachie says, Vancouver-Orient runs about 63%, Australia route is about 45%, and Vancouver-Buenos Aires is about 35%.

CPA discovered an unexpected traffic dividend in developing its Orient service-long-haul business from the Far East to Latin and South America. Im-

AIRLINE OBSERVER

► Edward Curtis, Presidential aide for airways planning, is being urged by close associates to reconsider his plans to return to industry after completing his report on aviation facilities planning. Curtis has emphasized that the proposed new airways modernization board (AW April 15, p. 29) should be headed by a man with broad technical and operational experience, but colleagues believe that his political stature and high-level connections would be more valuable in the new post than technical background.

► Airways Modernization Board recommended by Curtis parallels the organizational structure proposed last July for Air Navigation Development Board by Milton Arnold, vice president of the Air Transport Assn. (AW July 9, p. 40). Arnold, in testimony before the House Operations Subcommittee, urged the addition of a third member to ANDB who would be appointed by the President and confirmed by the Senate to sit with voting members of the Departments of Commerce and Defense as a means of breaking the ANDB deadlock. Arnold also suggested that a majority vote should be decisive just as Curtis has recommended for his board.

► Civil Aeronautics Administration is conducting tests on helicopter instrument flying in a move to advance scheduled helicopter service to an all-weather operation and eliminate the necessity of the "see and be seen" principle for helicopters in high-density areas.

► Civil Aeronautics Board reported to the House Appropriations Subcommittee that its personnel complement had decreased from 684 in 1948 to 621 in 1956. Emphasizing the need for an increased staff, Board Chairman James Durfee told the group that 557 applications were pending on the formal docket as of Dec. 31, the majority of which involved route authorizations that had been on file for over three years.

► Qantas Empire Airways will make a new bid for a route across the U.S. to England. Australian Director-General of Civil Aviation, D. G. Anderson, will arrive in the U.S. next month to resume negotiations.

► Civil Aeronautics Administration post of assistant to the administrator for legislative affairs, vacant since it was authorized two years ago, was filled today when Preble Staver, former Air Transport Assn. assistant to the president, joined the CAA to take over the position.

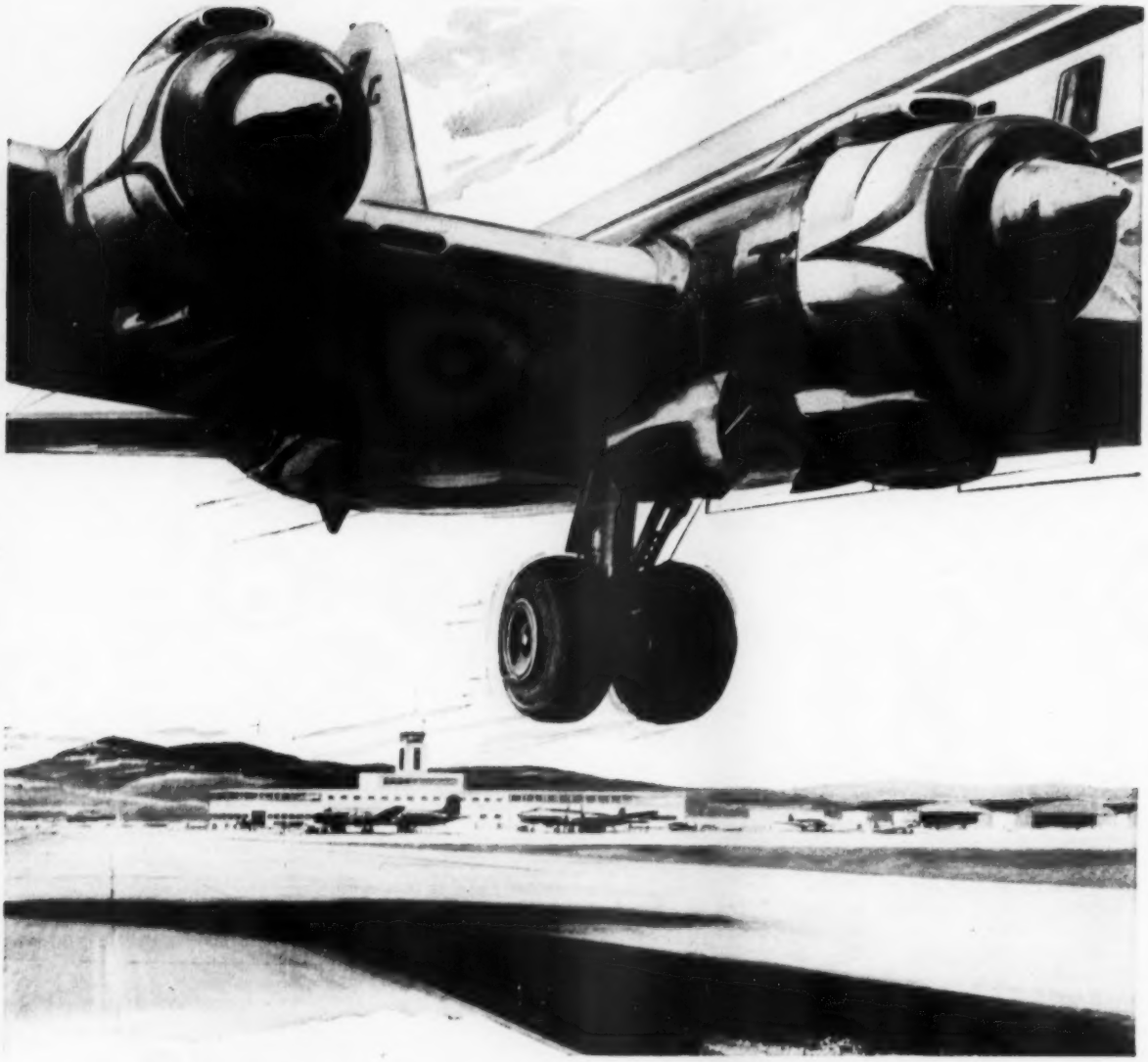
► Capital Airlines last week operated a Waco 9 biplane powered with an OX-5 engine from Pittsburgh to Cleveland in commemoration of the company's 30th anniversary. The two-place aircraft is the same model first flown on Capital's basic air mail route and was piloted by Merl Moltrup who made the inaugural run April 21, 1927.

► KLM Royal Dutch Airlines claims to have handled more east-west transatlantic export cargo than any other carrier during the first quarter of 1957. Machinery accounted for the largest proportion of freight shipped by the airline and included agricultural implements, automobiles, aircraft and construction equipment. Textiles and wearing apparel ranked second.

► Air Traffic Controllers Assn. will propose a comprehensive educational program to help reduce existing confusion on proper rules governing IFR holding patterns. Controllers charge that both pilots and controllers are often not clear on proper holding pattern procedures. Confusion exists, they say, because there is no single reference on the subject.

► Deutsche Lufthansa Airlines has signed an interline agreement with eight steamship lines that permit passengers holding roundtrip transatlantic tickets to switch from air to sea or from sea to air on return trips.

► Civil Aeronautics Board Chairman James Durfee predicts that air travel will exceed railroad passenger mileage for the first time next year. Durfee told the House Commerce Committee last week that commercial airlines flew 22.3 billion passenger miles last year as compared with 23.6 billion passenger miles recorded by the railroads. The Board chairman forecast a continuance of the trend with the airlines moving into first place in 1958.



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migration is a factor in this traffic, aided by the fact that Orientals can overfly the U. S. and thus obviate the need for any kind of U. S. visas. About 20% of CPA's Hong Kong-Vancouver passengers continue to Mexico or South America. Similarly, passengers on the Australia-Vancouver route continue to Amsterdam and thence to the United Kingdom (about 20% of them).

Reorganization

The airline's traffic and sales organization has been reorganized during the past year, according to Bryan Renwick, vice-president traffic. Increased sales efforts especially will be made in Eastern Canada as CPA enters this "biggest Canadian market with service to Europe as well as Mexico and South America. Renwick feels the Lisbon-South America service is a "significant new route," linking the South American countries with antecedent countries in Europe such as Portugal and Spain.

All the airline's international flights are mixed, with tourists running about 4 to 1 over first-class passengers, according to Renwick. Britannias also will be flown in mixed configuration.

CPA expects to hire 50 more pilots this year, for a total of 250. Personnel now total about 1,800 throughout the system, with 1,200 of them in Vancouver. The airline is spending $1.4 million on a new hangar and maintenance facility, which is scheduled for completion in time for the first Britannia delivery in September. Other expansion items include a $750,000 office extension and a $755,000 DC-6B simulator.

The airline is modifying eight C-46s formerly used in Dew Line operations as passenger-cargo aircraft for their northwestern services. The planes will seat 40 passengers.

Northwest Jet Order By August, Nyrop Says

Seattle—Northwest Orient Airlines expects to make a decision within four months on purchase of seven or eight Boeing Intercontinentals or Douglas DC-8s, Donald W. Nyrop, Northwest president, said here recently.

The long-range jets would be used in Seattle-Tokyo and Seattle-New York service, Nyrop said. They would enter service in 1960.

Purchase of eight to ten Lockheed Electra turboprops or four to five medium-range jets, such as the Boeing Model 707-120, also is reported under consideration for short-medium range assignments.

Northwest will double its hangar facilities at Seattle-Tacoma International Airport by 1960 at a cost of more than $2 million, Nyrop said.

Denial of Capital Family Fare Plan Recommended by CAB Examiner

Washington—Disapproval of a Capital Airlines family fare plan that extends the reduced rate to include Saturdays in addition to mid-week days has been recommended by Civil Aeronautics Board examiner Merritt Ruhlen.

The Capital tariff became effective March 30 when the allowable suspension period of 180-days elapsed prior to the completion of the CAB investigation of the petition.

Although the Board requested Capital to voluntarily postpone the adoption of the plan pending a final CAB decision, the airline chose to introduce the tariff with an extensive promotion campaign designed to attract Saturday family traffic.

In his initial recommendation, Ruhlen found the extension of the family fare plan "unduly preferential and prejudicial, unjustly discriminatory and unlawful." He did conclude, however, that the proposed fare falls "within the zone of reasonableness," and the bureau counsel held that the tariff is not unlawful.

If the Board upholds the examiner's conclusions, a CAB order for the cancellation of the tariff would now be required. American, Delta, National, Northwest and United have opposed the Capital plan.

How Plan Works

The family fare plan, which permits the head of a family purchasing a full-fare ticket to buy passage for each member of his family at half-fare, has been in effect over all routes of all trunk airlines since 1948. Passage with such tickets may be used only between Monday noon and Thursday noon. The Capital plan adds Saturday to the period that has fluctuated only slightly since its adoption.

In its petition on the revised plan, Capital argued that the addition of Saturday as a family-fare-plan day would divert a portion of its peak Friday traffic to Saturday, thus creating space for Friday's overflow traffic.

The airline estimated that the extension of the plan would increase annual passenger revenues by $571,272, net operating income by $255,598.

Capital said Saturday traffic was 26% lower than its average day traffic. Only 10% of its weekly traffic is carried on Saturdays, the airline said, as compared with 16%. On Fridays Capital added that Mondays are the second weakest day in terms of passengers

Airline Opposition

American Airlines reported a similar pattern but other opposition carriers found Saturday to be a relatively strong traffic day. National Airlines said Saturday was second only to Sunday trafficwise, with Wednesdays developing the smallest volume of the week. Monday was found to be the weakest traffic day for Delta, Northwest and United.

In a check of its reservations cards at New York, American found that 31% of its first-class Saturday traffic consisted of family groups, with 15% on Fridays and 20% on Sundays. In view of these findings, the airline estimated that if all Capital's family group traffic on Fridays and Sundays were diverted to Saturdays, it would lose $907,806 annually.

All opposing carriers complained that they would be required to adopt the Saturday plan if Capital is allowed to continue the tariff. American estimated the move would cause an annual diversion of between $700,000 and $2.5 million from its regular-fare traffic.

United estimated a reduction of at least $672,000 in annual revenues if the family fare plan is adopted generally on Saturday.

In making his recommendation against the inclusion of Saturday in the plan, examiner Ruhlen suggested a CAB investigation of the over-all family plan. He added:

"In such an investigation, the Board should include as an issue the appropriate adjustment to be made in all passenger fares if the family fare plan is found to be unlawful. This could prevent a fare increase if the family plan were eliminated."

Delta Places Stock On N. Y. Exchange

Delta Air Lines last week became the tenth domestic trunkline to be listed on the New York Stock Exchange.

Of the 12 major U. S. trunk airlines, only Continental and Northeast, which are listed on the American Stock Exchange, are not yet included on the big New York board.

First trading of Delta common stock took place Wednesday following approval of the listing by the Securities and Exchange Commission and the New York Stock Exchange. The company's outstanding shares currently total 1,122,525.

Symbol of the airline on the ticker will be DAL. Lenart, McHugh & Co. have been designated by the Exchange as the specialists for the Delta stock on the Exchange floor.

COCKPIT VIEWPOINT

By Capt. R. C. Robson

To Improve Aviation Now—Part I

The general emphasis on air traffic control for the future has tended to obscure the lagging development of our airports and landing equipment—a situation not waiting for invention but rather installation. Many air carrier cancelations, and most of the traffic jams, today can be laid on the threshold of these airports. The recent record-breaking flight of the Boeing 707 illustrates our plight. Washington National couldn't handle the airplane, Idlewild wouldn't. Hence Baltimore. Our dreamy traffic control system of the future will be wasted until we begin at the ramp and work out.

To be sure, we can't go on pouring concrete and building "finger gates" forever. But to park X number of aircraft we need X number of square feet of ramp space—terminal capacity is no mystery. The airlines themselves could help here by doing everything possible to reduce the ground time per plane in order to increase hourly capacity.

Parking Area

Moving from the ramp to the runway we find that anything much less than 7,000 ft. of pavement today can best be classified as parking area. To handle the larger jets of the future we will need 10,000 ft. Therefore, if you own a major terminal and wish to continue as such it is heartily recommended that you provide at least two runways of the appropriate dimensions.

Next we paint. All ILS runways should come equipped with CAA TSO-N10A Runway Paint Marking. And please fellows, it won't last forever so do keep a brush and bucket handy.

Now electricity. ILS runways should be adorned with modern high intensity edge lighting using 100-ft. longitudinal spacing. This means ANC Type C-1 lights or equivalent. Actually narrow gauge, flush runway lighting is probably the coming vogue but exact installation data will have to wait for final flight tests.

Need we mention approach lights? Complete configuration A (centerline) systems plus flashers should be attached to each ILS runway. Where real estate does not permit the full 3,000 ft., put in as much as possible. If you have a sheer cliff at the end of the runway, provide configuration A threshold marking plus two condenser discharge lights like those tested and used on Runway 31L at Chicago Midway.

Also, if you contemplate uninterrupted big plane service at your terminal, two complete ILS and approach light systems are needed. Cross country barnstorming to complete a circling approach is simply not the way to operate modern aircraft.

Adequate Visual Aids

The standardization of these handy little guides to finding a runway can hardly be overemphasized. All effort and money involved in the air plane, its flight, the traffic control system, the radio aids, the ILS and the gaudy terminal might as well be poured down the drain if the pilot is not provided with adequate visual aids for landing. These visual aids must be considered as much a part of the ILS as the glide slope and localizer. Their design and installation should not be left to local option.

An integral part of the landing system also is the cockpit instruments. To this end there must be a change in existing CAR to permit use of the new "T" panel. Omitting this has the same effect as forgetting the approach lights or any other essential ingredient.

The plea for most of these items is not new. On and off for the past six years substantially the same requirements have been outlined in this column. For the past six years very little has improved at the local aerodrome. How can we possibly discuss supersonic travel via push button control in 1970 when we don't even make use of existing know-how?

SHORTLINES

▶ **Boeing Airplane Co.** senior vice-president Wellwood E. Beall predicts that European airlines may double the orders for jet transports they now have with U. S. companies. Beall says most of the carriers with jets on order will have to increase their orders to meet route commitments and that carriers with no present orders will have to place them soon.

▶ **Pan American World Airways** will begin daily first class-tourist combination service between New York and Lisbon on April 28. Douglas DC-7Cs will be used on four flights without refueling stops at the Azores. The remaining three flights will use Douglas DC-6Bs. The new service will be scheduled into Lisbon and continue on to Barcelona, Nice and Rome. Pan American will begin daily tourist flights from New York to Nassau with Douglas DC-7Bs on April 28.

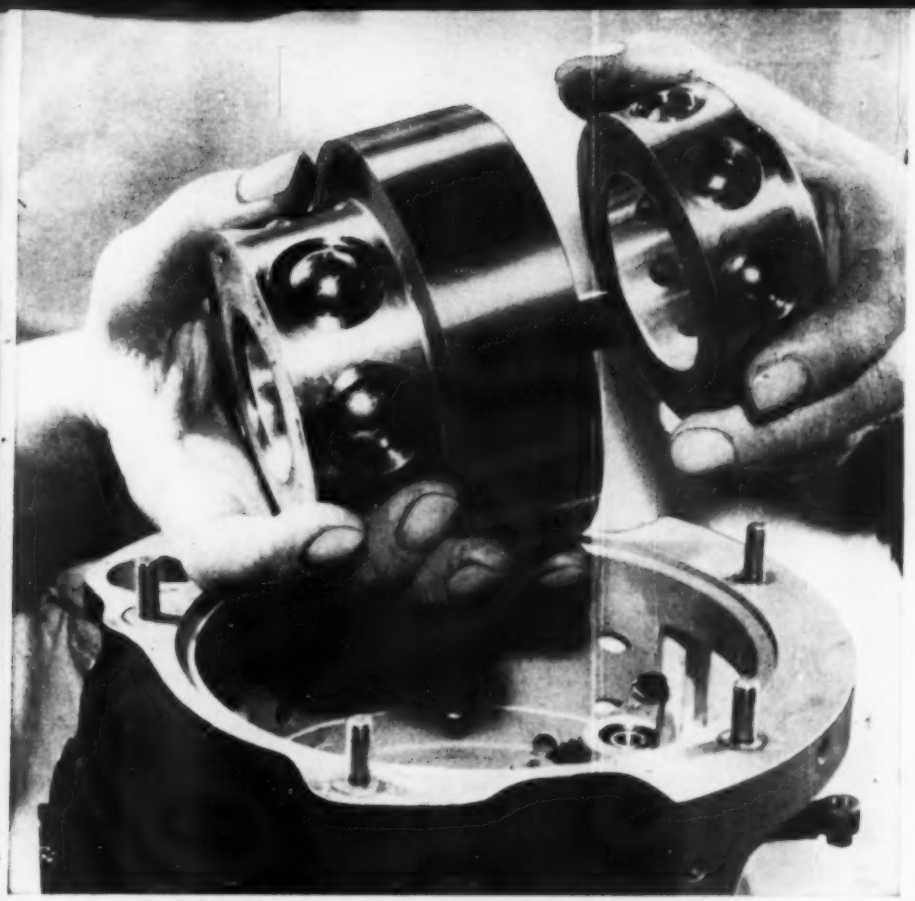
▶ **Braniff International Airways, Inc.,** will inaugurate Douglas DC-7C service between the U. S. and Latin America on May 16. The new twice weekly flights will operate out of New York to Washington and Miami by interchange agreement with Eastern Air Lines and continue to Panama, Lima, Sao Paulo and Rio de Janeiro. The service will be a first class-tourist combination.

▶ **United Air Lines** will operate a new "men-only" flight between New York and Chicago beginning April 28. The new flight will feature steak dinners, closing market quotations, pipe and cigar smoking.

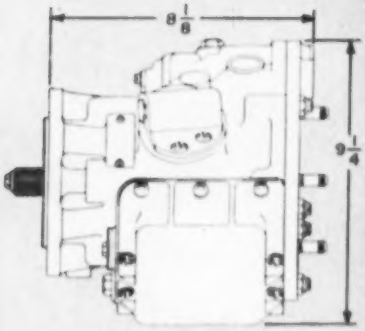
▶ **American Airlines** will offer Douglas DC-7 service from Boston to Cleveland and St. Louis beginning April 28. Effective May 1, the airline will begin DC-7 Mercury service from Boston to Chicago and San Francisco with a scheduled flight time of 10 hr., 20 min. Both flights will be on a first-class basis.

▶ **United Air Lines** will construct a $2 million hangar at Newark Airport with completion scheduled for the middle of next year.

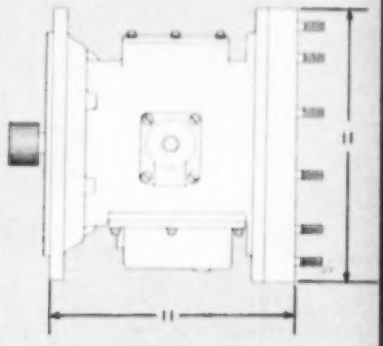
▶ **Northwest Airlines** will begin Douglas DC-7C service on it's Seattle-Tokyo route beginning April 28. With this new service, the airline will offer daily service over its transpacific route for the first time. The DC-7Cs will operate on a four round trip a week schedule. The remaining three schedules will be flown with Lockheed Super Constellations. Northwest will have all DC-7Cs on the transpacific route by fall.



MECHANICALLY SIMPLE ball piston unit shown being assembled in 20 KVA drive replaces conventional cylindrical pistons, connecting rods and bearings. Its use results in a more compact, lighter weight constant speed drive with fewer moving parts.



LIGHTWEIGHT 20 KVA DRIVE weighs 35 lbs. It delivers rated 32 hp over full input speed range of 4300 to 8300 rpm.



COMPACT 40 KVA DRIVE weighs 52 lbs. It delivers 63 hp over full input speed range of 3700 to 8300 rpm.

GENERAL ELECTRIC DEVELOPMENT SHOWS

How Ball Pistons Cut Size and Weight, Simplify Hydraulic Drive Design

General Electric Hydraulic Constant Speed Drives offer outstanding space and weight savings and design simplicity for any 400-cycle a-c electric system. You can combine these drives with any aircraft generator for use on piston, turboprop, or turbojet engines.

UNIQUE BALL PISTON DESIGN is the key to the small size, lightweight and mechanical simplicity of these drives. Operating on the simplest of principles, this radial piston hydraulic transmission uses precision steel balls in place of pistons, connecting rods and bearings. Extensive testing and thousands of hours of operational flying have proven this unit maintains high efficiency and reliability.

FEWER MOVING PARTS are required with this design. For example, since the balls are free in the cylinder and roll on the race, no separate bearings are needed to prevent contact friction, and the usual piston and connecting rod bearings are eliminated. The use of a journal bearing further cuts size and complexity. What's more, the mechanical governor system, which provides steady state speed control within ±1%, is an integral part of the transmission. Easily accessible parts simplify maintenance.

COMPACT AND SELF-CONTAINED, a typical 20 KVA drive measures only 8⅛ inches long and 9¼ inches in diameter. It weighs 35 lbs. A typical 40 KVA drive measures 11 inches by 11 inches and weighs 52 lbs.

Fine frequency control to ±1/10% and automatic paralleling can be provided with all General Electric Hydraulic Constant Speed Drives. For more information on these drives contact your General Electric Aviation and Defense Industries Sales Office, or send coupon for bulletins.

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Section A218-15, General Electric Co.
Schenectady 5, New York

Please send me the following hydraulic constant speed drive bulletins:

- ☐ Descriptive bulletin, GEA-6274
- ☐ Theory of Operation, GET-2480A
- ☐ immediate project ☐ reference only

Name .....

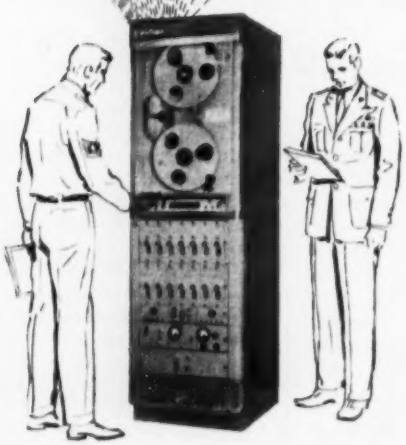
Position .....

Company .....

City ..... **State** .....

While this missile is in flight...

...telemetered data are recorded and simultaneously played back for computer use



Developed to record and reproduce missile data, Consolidated's new 5-752 Magnetic Tape System is also ideal for wind tunnels, engine test stands—wherever high speed acquisition of large amounts of precise data is essential. A compact, complete Magnetic Tape Recorder and Reproducer System housed in one steel cabinet, the 5-752 handles analog, PDM, and FM signals... provides seven individual tape tracks for simultaneous recording of separate signals on ½-inch tape. It also handles ¼, ¾, and 1-inch tape widths with a capacity of 5000 feet of 1.5-mil tape.

CEC's new magnetic

TAPE RECORDER/REPRODUCER SYSTEM

Frequency range of the 5-752 is from 0 cycles to 100 kc. Six tape speeds are provided in three groups—60 and 30 ips, 15 and 7.5 ips, and 3¾ and 1⅞ ips, with switching selectable from the front panel. Contact your nearby CEC field office, or write for Bulletin CEC 1576-X1.

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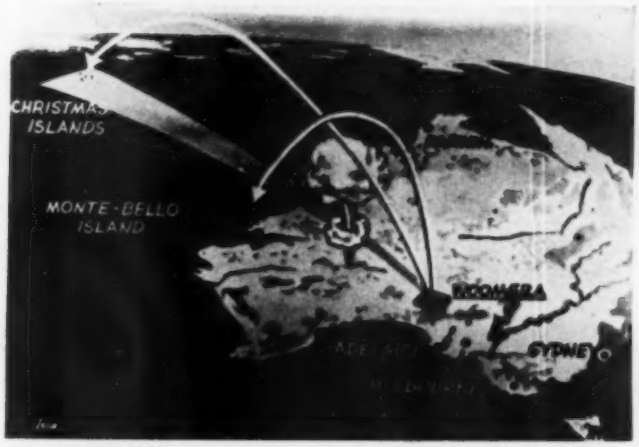
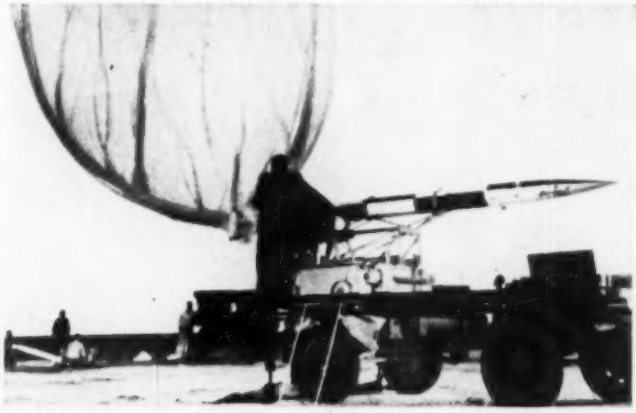


MAP SHOWING Woomera location in relation to Sydney, Melbourne and Adelaide. Mushroom burst is sited on Maralinga, permanent atomic test site.



HARP (High Altitude Rocket Projectile) commonly known as Rockoon will be fired from Woomera during International Geophysical Year.

UPPER ATMOSPHERE research vehicle Skylark is loaded into 58-ton launching ramp. Missile will reach 120 mi.

British Speed Woomera Missiles Work

Adelaide, South Australia – Soviet Premier Bulganin's scarcely veiled missiles threat at Suez-time and Britain's new and revised defense concept has goaded the country's guided weapons industry into a burst of energy.

Word has gone out officially that top priority is to be given to IRBM and ICBM projects.

The order also was passed to extend Woomera Range to give maximum overland distance. This will be up to roughly 1,300 mi. (IRBM range), and eventually clear to the Indian Ocean Christmas Islands. (As distinct from the similarly named Pacific group where the U.K. megaton bomb tests are to be held next month), a distance of roughly 4,000 mi.

The recent U.K.-U.S. summit talks cleared the way for Britain to accept some U.S. guided weapons to tide over the immediate need, but this, at the best, can only be a temporary measure. For one thing the radar network which will control Britain's outer defense ring is widely different than U.S. system and consequently extensive adoption of missiles other than those built expressly for the U.K. hookup cannot be made without considerable problems—and expense.

It seems highly likely, therefore, that any U.S. weapons adopted as a result of the Washington and Bermuda talks will be of a type which do not rely on or fit into the radar scanning system. But, why is Britain in the position where she has to shop abroad for hardware when, for 10 years or more, she has been designing and developing missiles of her own?

Basically, the answer goes back to 1947 when staff planners at the U.K. Defense Ministry figured there would be no global war requiring guided weapons, as then epitomized by the German V2, within 10 years.

The planners figured that intermediate weapons could be obviated and a limited budget conserved if a long-range policy could be adopted with something like 1957-8 as the target date for weapons to replace the bomber, fighter and anti-aircraft guns.

Broadly, the U.K. system of getting a guided missile from the idea stage to operation is along these lines:

- The British Air Ministry, thinking in terms of the next stage of aircraft development and the necessary armament (in the case of air-to-air weapons, say), studies the overall requirement and sets out its views and general specifications.
- The Supply Ministry approaches a number of manufacturers whom it thinks capable of carrying out such a project.
- From the replies, and over conference

From actual photo taken a few minutes after Lindbergh took off.

LINDBERGH Lands in Paris on Goodrich Silvertowns

SILVERTOWNS across the sea! Landing on the dependable resilience of Silvertown Airplane Tires, Capt. Charles E. Lindbergh in his Ryan monoplane "Spirit of St. Louis" won his fight with death and distance. The stalwart cushioning of Silvertowns absorbed the landing shock of the first airship to fly from New York to Paris without a stop.

Silvertowns started Lindbergh safely on his way past the dangerous, critical seconds of the take-off at New York.

Silvertowns delivered him safe at Paris — safe from the fateful impact as his eagle plane swooped from the sky, and slammed its wheels down on Europe.

The first thirty seconds of the flight — the last thirty seconds of it!

The first 1,000 feet on the ground after Lindbergh cried "Okay" and they jerked the chuck blocks away from the Silvertown-shod wheels! The last 1,000 feet as the great monoplane hurtled across the Paris landing field.

These were seconds of held breath and tense nerves. Would the tires stand up as the 5,150 pounds of the loaded plane hammered and battered them along the runway? Would they hold the 46-foot wingspread of the eagle ship true to the course?

Would a tire fail in those seconds of grave stress? A blowout spelled the end of the magnificent venture, perhaps with a still greater adventure for the man in the cockpit.

Less than a minute of time, yet an eternity of suspense, the overseas plane thundered along the gauntlet of disaster.

Silvertowns held! Their sinewy strength, their sturdy cushioning stood the stress and strain that had doomed a thousand flights. Capt. Lindbergh soared away safe and landed safe.

Silvertowns met the test as they met it when this unheralded challenger, Capt. Lindbergh, started on his flight from San Diego to New York and made it in less than twenty-three hours.

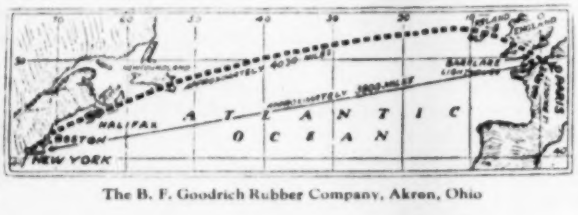
The dash through the clouds to Paris was a matter of gasoline, courage of the intrepid voyager of the skies — and Silvertown tires in the taking off over here and the landing over there.

The "Spirit of St. Louis" sped overseas a perfectly equipped airplane, instruments and parts the nearest to perfection ever assembled.

Captain Charles Lindbergh built it quietly at San Diego, counting on its mechanical perfection as well as his skill and courage to carry through to the goal.

And when it came to tires he fortified the security of his plane with Silvertowns. He underwrote the safety of his venture with the tires that have through years met the test of great moments of competition.

He called to his aid the same flexing strength, the same dependable endurance with which Goodrich Silvertowns have for years served the motor cars of the world.



The B. F. Goodrich Rubber Company, Akron, Ohio

Goodrich Silvertowns

BEST IN THE LONG RUN

This ADVERTISEMENT appeared in June, 1927

Now pilots land all over the world on B. F. Goodrich Tubeless

THE MOST SIGNIFICANT development in tires since Lindbergh's flight is Tubeless, pioneered and patented by B. F. Goodrich. Now in service with overseas airlines and military planes, B. F. Goodrich Tubeless sets the pace because it saves weight, performs better.

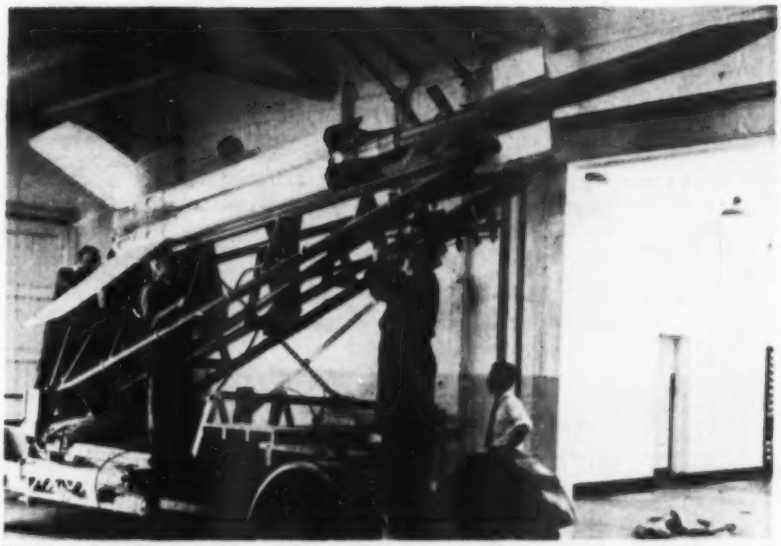
B. F. Goodrich Tubeless Tires are making greater payloads possible by reducing weight as much as 120 pounds per plane. And while saving weight, BFG Tubeless Tires offer superior air retention, save time and money in warehousing and maintenance. That's why the trend is to B. F. Goodrich Tubeless.

B. F. Goodrich Tires "cross the Atlantic" again on a replica of the SPIRIT OF ST. LOUIS in the Leland Hayward—Billy Wilder motion picture production of Charles A. Lindbergh's Pulitzer Prize-winning story, "THE SPIRIT OF ST. LOUIS"... with JAMES STEWART as Charles A. Lindbergh, presented by WARNER BROS.

B.F.Goodrich

AVIATION PRODUCTS

A division of the B. F. Goodrich Co.
Akron, Ohio



HIGH ALTITUDE control test vehicle (CTV) is one of basic research missiles in use at Woomera. Missile has sustainer motor. Rocket boosts shear away at burnout.

tables where necessary, one or sometimes more of these private firms are asked to go ahead and produce a test vehicle, with specific accent on tolerances, size, weight and space allocation.

- If this meets with Ministry approval a number of pre-prototype models are requested for more extensive examination and testing.
- Prototype models follow to iron out remaining bugs.
- Production is ordered with the trials of these units being carried out by service teams from the armed services.

One Accepted

Final acceptance depends on satisfactory progress through all these stages. To date only one British weapon has been officially announced as being accepted—the air-to-air Fairey Fireflash. The system, rigid and exacting, is similar to that observed for aircraft production. Perhaps the major difference is that few, if any, missiles develop as private ventures. A missile manufacturer is not aware of the overall defense program and the vast sums involved preclude indiscriminate wildcatting on the chance that something worthwhile might develop.

Reimbursement

A cost-plus system is adopted for reimbursement of manufacturers' efforts whether the project is successful or otherwise. Initial testing is carried out in most cases on the U.K. ranges at Aberporth and Larkhill or in South Australia at Woomera. Backing up the vast Woomera Range, now in the process of being extended, with its advanced tracking network, is the Weapons Research Establishment at Salisbury, near Adelaide, South Australia. Considerable resources are available here for checking and proving firing results.

Adjacent to WRE branches of the major U.K. firms engaged in the missile industry have been set up, involving the employment of possibly the most highly trained technical work force in the Commonwealth.

De Havilland one of the oldest established companies in the guided missile field, is one of the major contractors. It is widely accepted, although not officially announced that DH is developing an air-to-air weapon for fighter armament using what is generally regarded as a reasonably efficient infrared target seeking system of guidance. Short-ranged, but of high speed, the weapon is almost certainly solid-fuelled. It is known the weapon is well advanced and into the air trial stages and it could well be the next weapon to be unclassified in the AA division.

It was recently announced that Saunders Roe is to be associated with DH in a new project. The exact nature of the marriage was not announced but Supply Minister Howard Beale used the term "manyfold" in announcing a major expansion program. It is known that SR recently completed a new wind tunnel capable of Mach 3 and as the company is not known to be contemplating building an aircraft in this speed range, it is suggested that the new venture could be a joint effort leading to a new surface-to-air missile, or even the initial stage of the IRBM.

Fireflash

Fairey Aviation was the first British firm to become established at Salisbury and Woomera. It produced the Fireflash air-to-air weapon, now undoubt

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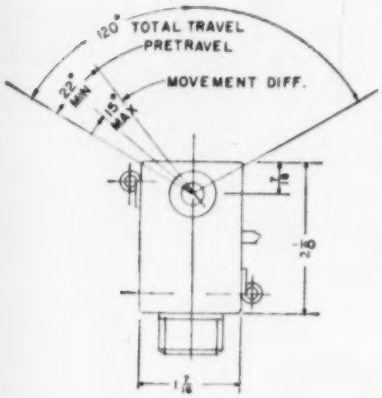
- Permits 120° rotary travel — a minimum of 50,000 cycles!
- Long overtravel eliminates need for fine adjustment; permits greater flexibility in linkage action.
- Tough, drawn-steel case. Rigid two-bolt mounting.



The many switching jobs done *best* by rotary-motion limit switches can now be done even better! Electro-Snap's new shaft seal gives you *positive* hermetic sealing, simplifies mounting, saves weight and space, and provides a full 50,000 cycle minimum life.

Elimination of external cranks, cams, links, and other gear to translate rotary to linear motion (as is often done to permit use of hermetically-sealed, lever type switches) reduces weight, space congestion, and the need for tedious adjustment. This simplicity gives you greater freedom in locating interlock and indicating switches on rotary mechanisms; allows positive linkage attachment.

Ice, altitude, rain, or corrosive atmospheres cannot effect this Electro-Snap switch sealed in a dry, inert gas. The steel case protects against shocks; prevents loss of the hermetic seal—also permits tight draw-up on mounting bolts without "springing" the case.

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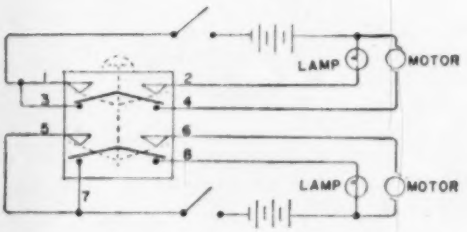
TYPICAL CIRCUIT



1-2—Remote Lamp indicates when arm is fully returned.
3-4—Motor driving linkage counter clockwise 120°.
5-6—Switch stopped motor at predetermined position.
7-8—Remote lamp indicates arm at full travel position.

ELECTRO SNAP

ELECTRO-SNAP
SWITCH & MFG. CO.
4322 W. Lake St., Chicago 24, Ill.

edly being used as a training combination with Hunter and Swift fighters in the UK and with Avon-engined Sabres in Australia.

Fireflash is a fairly simple dart whose propulsion is gained from twin boost rockets positioned above and below the missile itself. At burnout, when a high supersonic speed is reached, these motors shear away, leaving the unpowered, beam riding missile to coast freely for several miles.

Vickers-Armstrong missile, which fell by the wayside, was the air-to-air weapon which this company was developing for arming the Gloster Javelin Mark 1. Whether the aircraft or the weapon was untimely was not disclosed when the contract termination was announced last year.

It can be said officially that Armstrong Whitworth is currently developing a naval guided missile, the contract being with the British Admiralty and not as is normal, with the Supply Ministry.

The missile is believed to be well advanced although by no means near the production stage. Sperry is associated with the control system and General Electric is engaged on the guidance work.

The missile has been extensively tested at Woomera and it would follow that the next trial stage will be from the newly commissioned HMS Girdleness, the Royal Navy's first missile ship.

Bristol Rise

Bristol has risen rapidly into the limelight in recent years and is today heavily committed to the guided weapons program. Knowledge of the company's Thor ramjet makes it obvious that its role is the development of a surface-to-air missile with a substantial range, using Thor as a sustainer motor assisted in take-off by rocket motors. Its speed is well into the Mach plurals, its range limited only by fuel-carrying capacity. Cheapness of the ramjet—one estimated puts it at about £1,000—adds to the rosy future which the company has in this field. The electronics company of Ferranti are known to be associated with the guidance and control systems.

It has been claimed that English Electric is one of the few British groups able to carry out entire production of a missile—if not the only group. Currently engaged on production of a surface-to-air missile, tests are extremely encouraging. The company has an extensive trials team on the Woomera Range. Napier is associated on power and Marconi on guidance. The missile consists of a main rocket surrounded by eight boosts arranged in pairs giving a formidable take-off speed.

A. V. Roe, only recently established in Australia, is believed to be undertaking Britain's first venture into the air-to-surface field. One line of thinking suggests that the company's own Vulcan V-bomber might be the aircraft to be linked with the missile.

Emi Engineering Development, Ltd., a branch of the world-wide musical and instrument company, is not engaged on a missile itself, but is an important ancillary unit providing much of the electronics and telemetry systems for range trials. It is also believed to be active on proximity fuse work.

Geography

Woomera is both a town and a range, the products of a joint UK-Australian agreement signed in 1946, and on which, to date, Australia has spent something like £60 million and Britain possibly twice that figure. Nearest capital city is Adelaide, 300 miles southeast, an outer suburb of which is Salisbury where the range's base facilities and laboratories are situated.

Woomera village comprises 500 or 600 permanent brick, timber, or aluminum homes, a school, hospital and theatre, and enjoys its own power supply, water drawn through a 250-mile pipeline, and normal social services. Here live the technicians and scientific staffs of both the private companies who test their weapons on the range and the

The Men Who Are Air France
No. 6 OF A SERIES
CAPTAIN ANDRE LESIEUR
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AND A FUTURE
Captain Lesieur's past 10,000 hours of flight figure importantly in the future of Air France. His experience flying Super Constellations over the Atlantic (120 crossings) will smooth the integration of the new Lockheed Super Starliner into the Air France fleet. His hours at the controls of Comets and Caravelles will be indispensable in the coming changeover to jets. His well-rounded operational background is typical of the men of Air France. It is men like Captain Lesieur who will make it possible to carry on Air France's record of dependable service to the peoples of 73 countries in the generation ahead.
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The Super Ventura, with the most amazing single engine operation in the executive field, cruises at more than 300 miles per hour — more than 2,000 miles non-stop — with up to 14 passengers and 1,500 pounds of baggage.

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government staffs who control the range.

A sizeable single men's area caters largely for construction workers, and barrack-style camps provide accommodation for troops of the three services who have need to learn the missile operating and handling techniques.

It is of interest to note that the present Range Superintendent is a Royal Navy captain, he having succeeded an Army general and an Air Force group captain.

The village is flanked to the northwest by an all-weather, heavy-duty airfield with capacity to handle major maintenance and repairs to aircraft ranging from the Valiant V. bomber used for high-level ballistics trials, through Superforts, Canberras, Meteors, veteran Mustangs and Beaufighters, to Jindivik, the pilotless jet target aircraft designed and developed by the Australian aviation industry.

This airfield is the range terminal for the "pipeline" courier service which has operated for nearly 10 years bringing missiles for testing, equipment for installation and missilemen out from the UK.

Forward Base

Forty miles further northwest lies the forward base of Koolymilka and adjacent, the firing pads, launching ramps and instrumentation blocks into which filter the down-range recordings of flying missiles.

To even enter the village of Woomera a pass is needed, special dispensation is required to get beyond the street limits, but at Koolymilka, a road block, armed guards and man-proof fences bar progress to all but those entitled to pass forward.

Initially, the range extended only 45 miles, fanning northwest over dead-flat, gibber-strewn red desert, speckled with native saltbush on which sheep thrive 20 to the square mile. Annual rainfall is 8 inches, and that usually in three or four downpours.

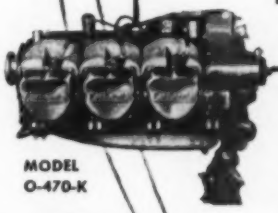
Temperatures run as high as 120F regularly in the summer shade, and as low as 40F in the winter nights. But the clear skies, infrequent wind storms and long hours of daylight make weather conditions the most perfect in the world for missile testing.

Today, the range extends for some hundreds of miles—no-one will admit the exact limit. Concrete pillboxes housing radar-controlled cameras, electronic tracking instruments and measuring equipment stud the flight line every few miles. Late last year an aerial survey was completed to carry the range through to the West Australian coast and, spurred by the present urgency, construction workers are pushing ahead day and night with a road to follow this route.

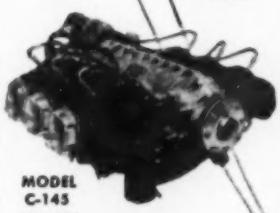
Construction of monitor posts, tele-

Keep These Modern Facilities BEHIND THE PLANE YOU FLY

CONTINENTAL'S FACTORY RE-MANUFACTURE
Backs You with Factory Knowhow—and Precision Production Machinery—Throughout Your Engine's Life



MODEL O-470-K



MODEL C-145 (O-300)

MODEL E-225

No two ways about it: the men and machines that produced your airplane engine in the first place are obviously best qualified to keep it in top running condition. That is why Continental's Factory Re-Manufacture Plan is rapidly supplanting the periodic overhaul among users of utility planes. Factory Re-Manufacture gives every owner the benefit of precision facilities and knowhow that simply can't be matched in the field. You get new engine warranty, along with new engine safety and dependability—in a fraction of the time required for overhaul—and new log book with zero engine hours—all this at a *modest predetermined* price. Get in touch with your Continental distributor or write for information.

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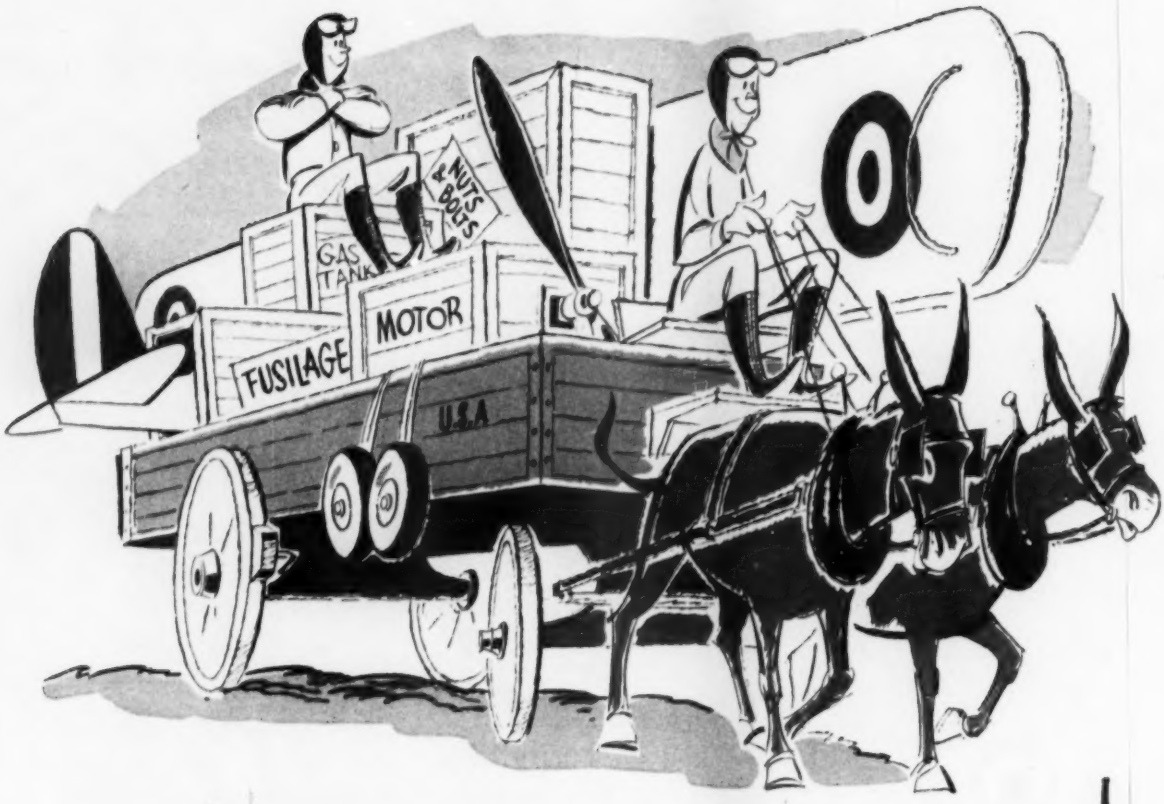


how specs have changed!

On Dec. 23, 1907, this was a Department of War specification for a "heavier-than-air flying machine":

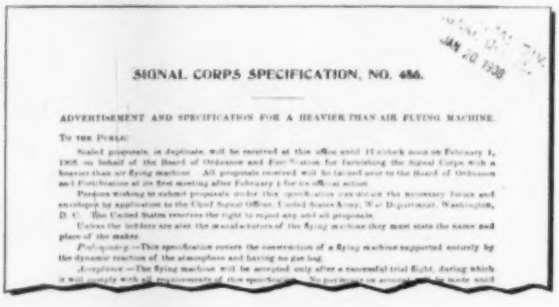
> **"It is desirable that the flying machine should be designed so that it may be quickly and easily assembled and taken apart and packed for transportation in Army wagons. It should be capable of being assembled and put in operating condition in about one hour."**

L·O·F probably couldn't have helped you much with *that* problem. But we *can* help you with your present problems.

Here's a "for instance": our engineers have recently developed improved techniques in electrical filming of aircraft glass—even odd shaped parts and curved units—to provide improved defogging and deicing under extreme altitude and weather conditions. (Douglas F-5D and AVRO CF-105 *Electrapane*® Windshields are good examples).

If you have any questions concerning the latest developments in aircraft glass write it out and send it to Aircraft Division, Libbey·Owens·Ford Glass Company, 608 Madison Avenue, Toledo 3, Ohio.

ALSO ASK FOR A COPY OF *The Original American Army Contract for Aeroplanes* suitable for framing.



SIGNAL CORPS SPECIFICATION, NO. 486.

ADVERTISEMENT AND SPECIFICATION FOR A HEAVIER THAN AIR FLYING MACHINE.

To the Public:

Sealed proposals, in duplicate, will be received at this office until 12 o'clock noon on February 1, 1908, on behalf of the Board of Ordnance and Fortification for furnishing the Signal Corps with a heavier than air flying machine. All proposals received will be turned over to the Board of Ordnance and Fortification at its first meeting after February 1 for its official action.

Persons wishing to submit proposals under this specification can obtain the necessary forms and envelopes by application to the Chief Signal Officer, United States Army, War Department, Washington, D. C. The United States reserves the right to reject any and all proposals.

Unless the bidders are also the manufacturers of the flying machine they must state the name and place of the maker.

Performance.—This specification covers the construction of a flying machine supported entirely by the dynamic reaction of the atmosphere and having no gas bag.

Aeroplane.—The flying machine will be accepted only after a successful trial flight, during which it will comply with the requirements of this specification. No part [illegible]

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graph links, staging camps and installation of equipment is scheduled to follow in fiscal '57-8, by which time Britain hopes to have weapons requiring at least that range limit. It has already been admitted officially that one missile powered by Bristol's Thor ramjet, has exceeded the present range limits.

Authority controlling the range is a departmental body known as Weapons Research Establishment (WRE), answerable directly to the Department of Supply in Australia and to the Ministry of Supply in the U. K.

What little official light is shed on activities both at Woomera and Salisbury is usually jointly released by Supply Minister Howard Beale in Australia and his counterpart, Aubrey Jones, in the UK. WRE, in effect, is responsible for creating and maintaining the facilities with, or on which, a dozen private British aviation and engineering firms carry out trials of their weapons or weapons systems.

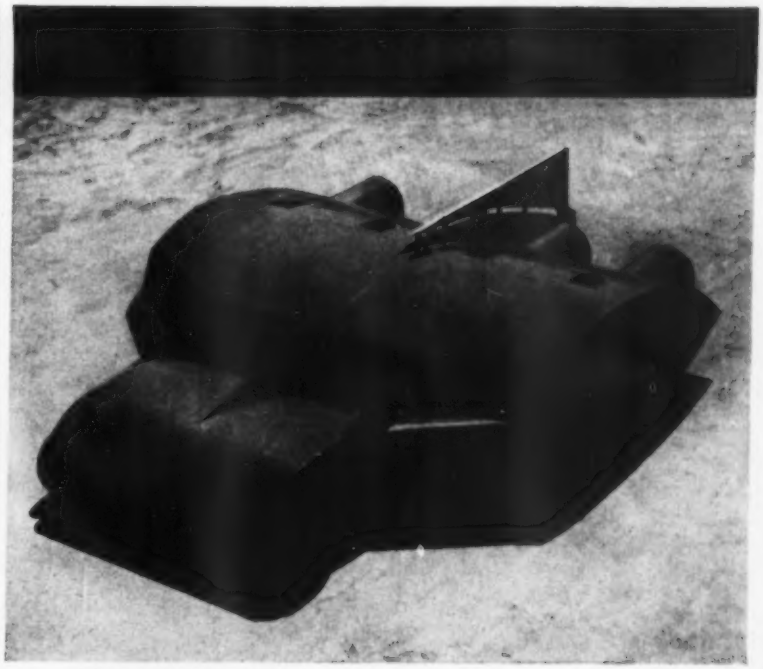
Data Processing

These companies have been given accommodations in a former wartime munitions plant area adjoining WRE's Salisbury headquarters, the whole of which is under close security. They receive from their U. K. plants the missiles for testing, usually in knocked-down form, assemble them and use their own teams for actual range firings. Evaluation of results is supplied to the contractor after data processing on WRE's electronic computors.

These computors are also widely used to synthesize problems on behalf of contractors.

Unlike the U. S. system whereby a missile project is given a colorful-code-name almost from its inception—a name which quickly becomes a byword in the industry—the U. K. system does not disclose publicly even a hint of a name. In fact, while a secret code-name is applied throughout the design, development and testing phases, supposedly known only to those associated with the program, a completely different name is given to the finished hardware. An instance of this was the Fairey Fireflash air-to-air fighter armament weapon officially cleared last year. Its development code-name was a vastly different, seven-letter alias.

WRE does not stop at providing facilities for others. It has a number of branches of its own undertaking pure research into propulsion systems, equipment design, avionics, development of test vehicles in association with Royal Aircraft Establishment (RAE) Westcott, U. K., and is currently installing the most powerful wind tunnel in the southern hemisphere of Mach 3 capacity. It has produced high-class gyros on the one hand and huge transporter units on the other, but its primary role is



FOUR JET CAR

Helpful Hot Rod

The hottest hot rod on wheels today was developed by All American. But far from being a threat to life and limb this hot rod is used to *save lives.*

Powered by four jet engines, the car makes speeds of more than 200 miles per hour and is used to simulate a landing jet aircraft. Its main purpose is to drive loads at high speeds into aircraft arresting gear to test the strength and durability of the gear. On how well these arresting gear hold up may depend the life of an Air Force or Navy jet pilot.

The jet car was All American's answer to the difficult problem of how the speed of a landing jet aircraft can be attained on the ground with a load equal to the weight of an airplane. This and other tough problems for the Armed Forces and industry are All American's business.

Every engineering idea receives consideration at All American.

Engineers who can tackle these vital problems with a spirit of daring and imagination contact Walt Jones, Personnel Manager, All American Engineering Company, Box USS 2668, DuPont Airport, Wilmington 5, Delaware.

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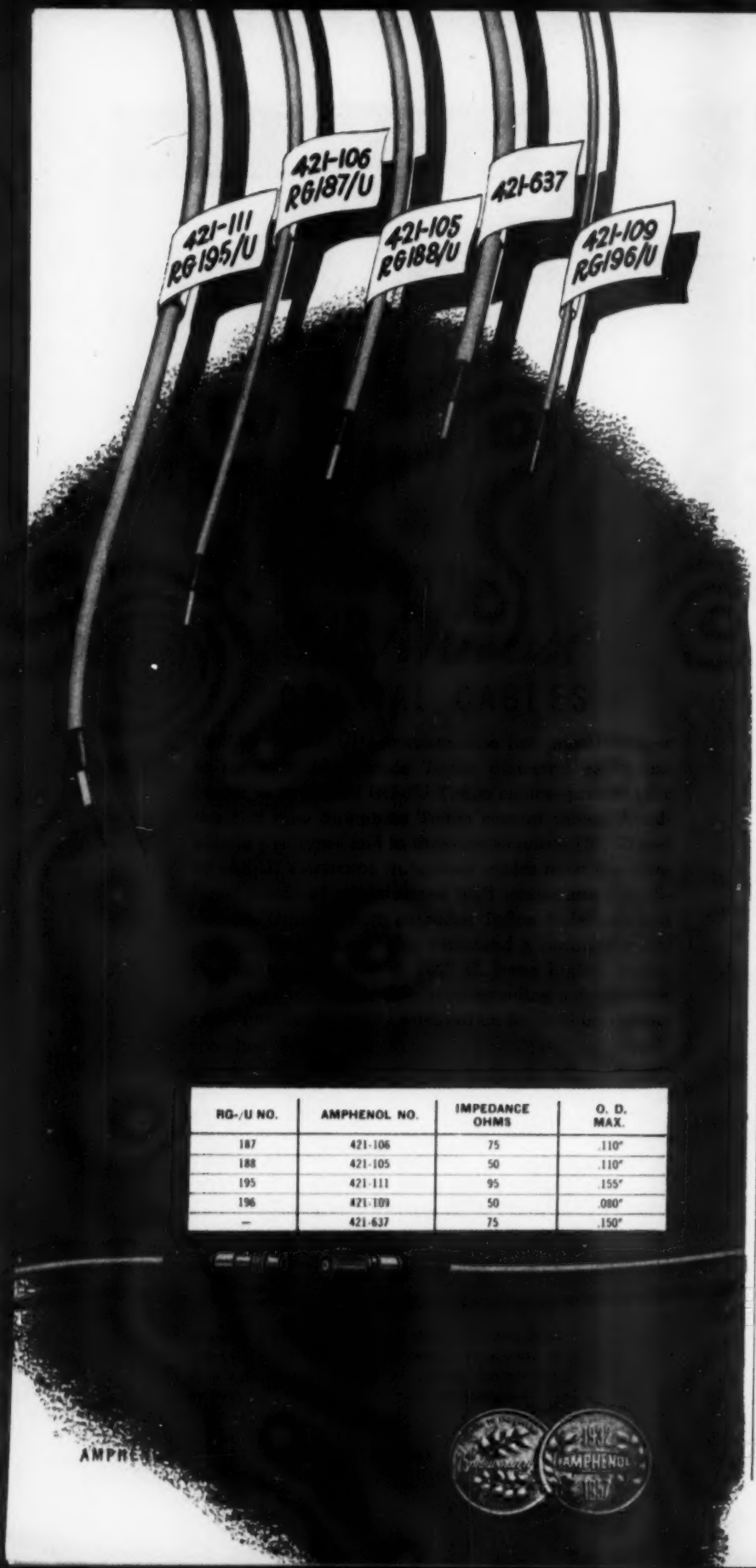
DUPONT AIRPORT • WILMINGTON, DELAWARE



RG-/U NO.	AMPHENOL NO.	IMPEDANCE OHMS	O. D. MAX.
187	421-106	75	.110"
188	421-105	50	.110"
195	421-111	95	.155"
196	421-109	50	.080"
—	421-637	75	.150"

that of providing the means for proving the products of private enterprise.

These products include a number of air-to-air weapons, surface-to-air and surface-to-surface missiles and there is growing proof that at least one air-to-surface weapon may be under way. Current firing programs are a long way short of the range's capacity.

No official figures have been given of the work load at Woomera, but it is known that the rate could be stepped up perhaps tenfold before causing embarrassment. Night firings, for instance, are rarely undertaken and there is generally a wide stand-down at weekends.

One estimate of operating costs has been put at £10 million a year, but just what this includes or leaves out puts the figure into the guesstimate class. Total personnel engaged in the industry, private and governmental, probably approximate 10,000, the majority of whom are governmental.

Standing behind the private companies established at Salisbury, of course, are the parent companies and groups, including Fairey, English Electric, General Electric of England, Armstrong Whitworth and Bristol, solidly committed to the guided weapons industry to the tune of millions of pounds and employing many thousands. And behind them again, stand more than 400 smaller companies subcontracting to the weapons which have been suddenly jerked into Britain's defense program.

Radiation Increases Efficiency of Fuel

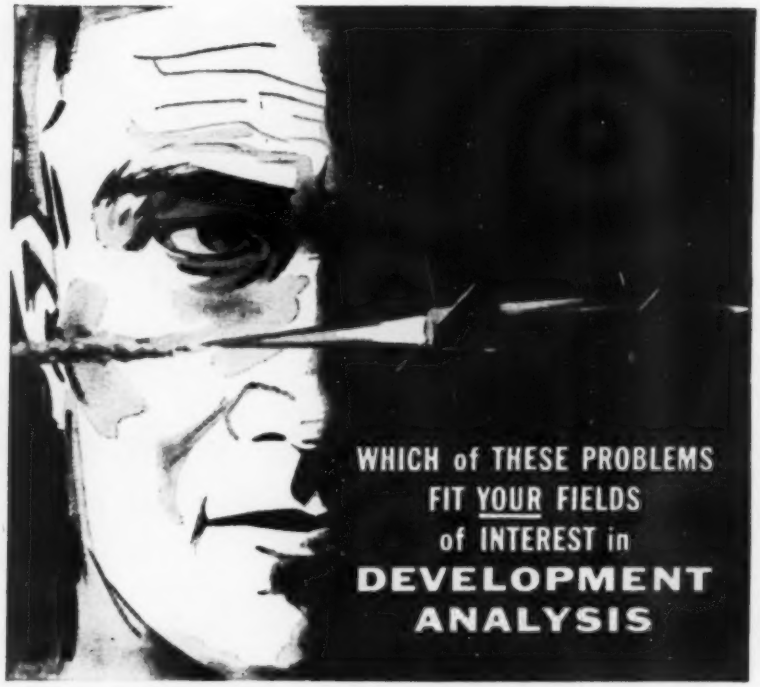
Intensely radioactive gold can increase the burning efficiency of fuel by 50%, a University of Michigan chemist, Stuart W. Churchill, told the American Chemical Society annual meeting in Miami last week.

In an experiment sponsored by USAF Office of Scientific Research, effects of different types of radiation on combustion were tested by engineers of the university at a site at Willow Run airport. Stream of propane, directed though a one-ounce nest of gold wire .003 in. diameter, was the first test to show a strong reaction, largely because of the intense strength of the gold radiation—rated at 10,000 Curies.

Other fuels would behave the same way as propane, the experimenters believe, and they found the results the same for all fuel-air mixtures tried and at atmospheric pressures equal to 30,000-50,000 ft. altitude.

Professor Churchill said the discovery might mean nuclear radiation could give small engines the thrust of larger ones with a significant weight saving, or that existing engines could attain higher altitudes.

The gold lost most of its potency



Through the years Bell Aircraft's rapidly advancing design concepts for aircraft and missiles have placed an ever growing importance on specific knowledge of aerodynamic and structural behavior. Our present projects and those planned for the future offer challenging opportunities for engineers capable of creating aerodynamic designs which successfully meet advanced requirements for performance, air loads, stability, control, maneuverability and aerodynamic heating. Similar opportunities exist in the solution of structural problems, in designing and testing structural components and assemblies, and determining structural design loads, methods and allowables.

Some of the problems which are under extensive investigation at present are:

AERODYNAMICS

1. Fluid flow and boundary layer analysis at hypervelocities and low Reynolds Numbers.

2. Aerodynamics analysis, design and testing of supersonic missiles and aircraft employing rocket, turbojet and ramjet propulsion.

STRUCTURES

1. Prepare charts for the selection of the optimum type of construction and the best material for various structural elements at elevated temperatures.

2. For a specified permissible missile loss rate due to gusts, determine by means of probability study the design gust velocity to be used in establishing loads for structural analysis.

For further information regarding employment opportunities in Research, write today: Manager, Technical Employment, Dept. E-6, Weapon Systems Division,

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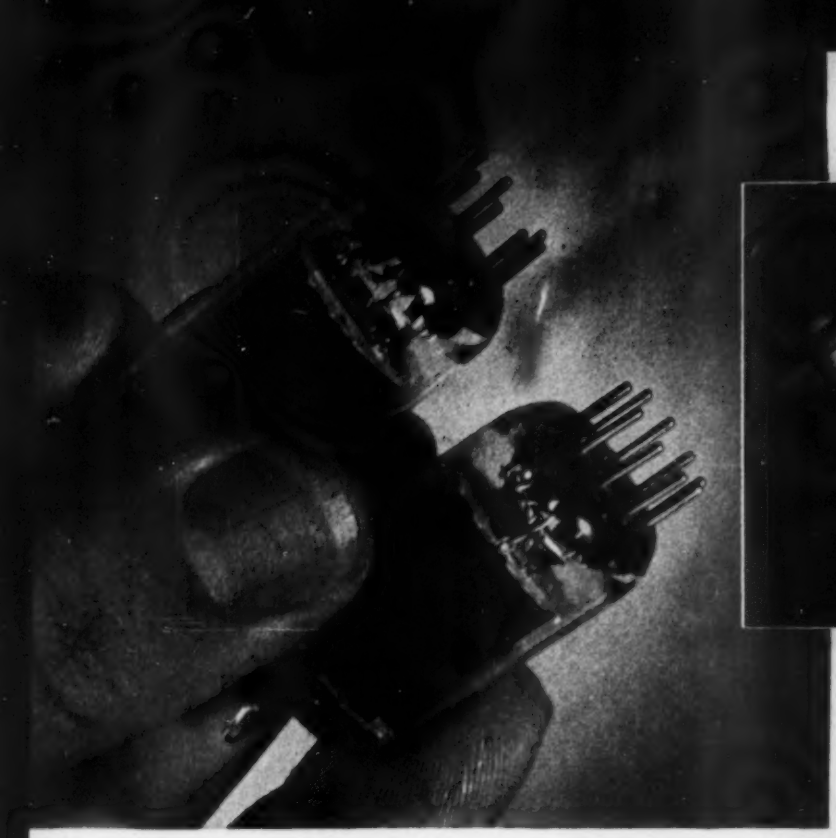
- Dynamic Engineers
- Electronic Engineers
- Electronic Standards Engineers
- Engineering Computers
- Environmental Specialists
- Field Test Engineers
- Flight Test Engineers
- Flight Test Programmers
- Fuel Injection Specialists
- Gear Designers
- Guidance Engineers
- Gyro Specialists
- Heat Transfer Engineers
- Hydraulic Engineers
- IBM Programmers
- Instrumentation Specialists
- Laboratory Test Engineers
- Magnetic Amplifier Specialists
- Mathematical Analysts
- Mechanical Engineers
- Microwave Engineers
- Miniturization Engineers
- Nuclear Physicists
- Operations Analysts
- Physicists
- Power Plant Designers
- Pressure Vessel Designers
- Project Engineers
- Publication Engineers
- Radar Systems Engineers
- Reactor Designers
- Reliability Engineers
- Rocket Test Engineers
- Servo Systems Engineers
- Servo Valve Engineers
- Statisticians
- Stress Engineers
- Structures Engineers
- Specification Writers
- Technical Writers
- Test Equipment Engineers
- Transformer Design Specialists
- Transistor Application Engineers
- Thermodynamic Engineers
- Telemetering Engineers
- Turbine Pump Designers
- Vibration & Flutter Analysts
- Weapons Systems Engineers
- Wave Guide Development Engineers
- Weights Engineers



ABOVE: operator holds a 5-Star high-reliability tube while streams of abrasive emulsion scour oxidation off pin surfaces.

LEFT: pins before and after cleaning. This is an unretouched photo.

General Electric "Sand-Blasts" 5-Star Tube pins for increased reliability in aviation equipment!

● General Electric "sand-blasts" the pins of 5-Star high-reliability tubes for complete and lasting electrical contact. This special process is part of General Electric's 5-Star program to build extra-dependable tubes for airborne communications, radar, and other critical avionic equipment.

Miniature-tube stem-making and bulb-sealing involve high temperatures that cause non-conductive oxidation to form on the pins. In "sand-blasting", twin guns spray jet-propelled streams of abrasive emulsion over the pins. This abrasive scrubs away all oxidation residues and leaves the full pin surfaces conductive.

At every stage of 5-Star Tube production, General Electric strives to provide the superior performance so vital to safety in airborne operation. Tube design is extra-rugged, will withstand shocks and vibration met in flight. Impurity-free manufacture in surroundings of "Snow-White" cleanliness protects electrical stability . . . and extremely rigid test procedures promote uniform reliability when tubes are installed.

Major airlines around the globe rely on General Electric 5-Star Tubes. Install this *proved* dependability in your own avionic equipment! Phone your local G-E tube distributor today! *Electronic Components Division, General Electric Company, Schenectady 5, New York.*

Progress Is Our Most Important Product

GENERAL ELECTRIC

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within three weeks, leaving no waste problem. However, the question of shielding remained. The experimenters used thirty tons of bagged cement and 1½ tons of lead sheet around the apparatus. Even then 20 engineers were needed for the project, because work had to proceed 24 hr. a day and each individual could remain in the area only a short time.

USAF Missiles Facility Moved to Norton

Los Angeles—Ballistic missiles logistical support functions, now located at Maywood Air Force Depot, will be transferred to Norton Air Force Base at San Bernardino, Calif., in the near future because of overall economy measures. Col. Philip B. Foote becomes deputy commander for ballistic missiles at Norton, and will head the ballistic missile management group.

In the new assignment Col. Foote will report to Gen. E. W. Anderson, commander of the San Bernardino Air Materiel Area and will receive directional control from Gen. Ben I. Funk, who is deputy director for ballistic missiles, Air Materiel Command, and chief of the ballistic missiles office at Inglewood, Calif.

The ballistic missiles office is one of three team members of a military-civilian management team carrying out the ballistic missile program for the Air Force. Ballistic missiles office is responsible for procurement and production, supply, maintenance engineering, quality control and transportation in the ICBM and IRBM program for Air Force. Western Development Division of ARDC, the team managers, and the guided missiles research division of Ramo-Wooldridge Corp.

New Company Formed In Rocketry Field

Los Angeles—Era Engineering, Inc., Santa Monica, Calif., has been formed for development of new systems and equipment in rocketry and electronics.

Era Engineering already announces these three systems now available:

- Simple system for measuring distance between missile and target in near-miss situation. System will assess effectiveness of missiles under experimental firing conditions, make available data to firing crews immediately after impact.
- Device for measuring erosion of missile surfaces under hypersonic environments. (Projected is a system for measuring and recording thickness of skin material as a function of time.)
- Radioactive recovery technique for missiles and components after experimental firings.

DELEGATION FROM Hungarian People's Republic view new transport, IL-14, during a meeting held at Moscow airplane factory.

New IL-14 Much Improved Over IL-12

(The article below was written for Grazhdanskaya Aviatsiya, the magazine of Aeroflot, Russia's airline, and is being reprinted in AVIATION WEEK *because of the growing importance of the IL-14 in Russian civil transport. In addition to going into large scale Aeroflot service, the airplane is being presented by the Soviets to the leaders of such countries as India, Yemen and Iraq to gain goodwill and political advantage)*

By Engineer-Pilot V. Bragin

The IL-14 aircraft is a cantilever, low-wing monoplane with retractible landing gear and nose wheel, and a single-fin empennage. Its fuselage is of semi-monocoque type with stressed skin. It is distinguished by a long, streamlined configuration.

The following geometric characteristics of the wing exert a great effect on the plane's flying and operating characteristics: the planform, the relative thickness of profile, the span, the aspect ratio, etc. The wing was derived from a modified TsAGI SR-5M profile. Its relative thickness; that is, the relation of maximum height to chord, is 18% at the root and 12% at the tips. For comparison we recall that the relative thickness of profile for the IL-12's wing is 16 and 10%, respectively. The TsAGI SR-5M profile, as compared with the IL-12 wing profile, provides a considerable reduction in the wing's profile drag with the same lift qualities.

In plan, the wing has a trapezoidal shape and a sweepback angle of 3 degrees. Thanks to the sweepback, there is a component of the speed of air flow directed along the wing span from the ends to its root section. The breaking up of the flow at large angles of attack is moved from the end section to the root section, which exerts a favorable effect on the plane's lateral controllability and improves the work of the ailerons.

The wing area is 100 square meters. Its size answers an important requirement of aerodynamics: to ensure low landing speed along with a comparatively-high cruising speed. For the IL-14, these indices are 140 and 358 kilometers per hour. Loading on the IL-14's wing is 172.5 kilograms per square meter. Aspect ratio is 10.

The engine nacelles are streamlined in shape. The exhaust stacks do not protrude outward but are inscribed in the contour of the nacelle. The air intakes are also concealed. The exhaust stacks are brought out to the trailing edge in the decompressed zone.

Because of the improved aerodynamic characteristics of the wing and nacelles, the IL-14's cruising speed is increased by 15 to 20 kilometers per hour as compared with the IL-12. Closing the landing gear doors while the gear is extended improves the takeoff characteristics and, in addition, permits hori-

ANGLES OF ATTACK AND AERODYNAMIC EFFICIENCY (LIFT-DRAG RATIO)

ANGLES OF ATTACK IN DEGREES	IL-14	IL-12
0	4,85	2,65
2	9,9	5,8
4	12,4	8,4
6	13,2 *)	9,9
9	11,8	10,0 *)
12	9,9	9,9

* OPTIMUM ANGLE OF ATTACK

zontal flight and even a slight gain in altitude near ground level with one operating engine when the propeller of the non-operating engine is feathered.

Time required for retracting the landing gear is 5 seconds in the summer and 6 to 7 seconds in the winter.

The IL-14's wing mechanization consists of two split flaps with an overall length of 18.8 meters, which is 59.3% of the wing span. With deflection of the flaps 20 degrees, the aerodynamic efficiency (lift-drag ratio) of the plane in the range from minimum speed to a speed of 175 kilometers per hour is more than with undeflected flaps. Therefore, the action of the flaps on the wing's operation is very effective.

The sturdy vertical empennage, the correctly-chosen lateral V of the wing, and the large span of the ailerons ensure good lateral stability and controllability.

The increase in the area of the vertical empennage is due chiefly to the larger rudder. Its greatest angle of deflection on both sides is 25 degrees. On the rudder is a spring compensator by which the loading on the leg in single-engine flight is decreased and the plane's lateral controllability is improved.

The area of the horizontal empennage is increased by 6% as compared with the IL-12 aircraft.

In the range of operational balance from 13 to 18.6% mean aerodynamic chord the plane has adequate longitudinal stability and controllability.

Anti-Icing

In order to prevent impairment of the plane's aerodynamic qualities due to icing, the leading edges of the wing, the stabilizer and fin, the propellers, and the front glass of the cockpit have anti-icing devices.

Takeoff power of the ASh-82T engines used in the IL-14 is 1,900 hp. at 2,600 rpm., and manifold pressure of 1,250 millimeters of mercury column. This is 50 hp. more than the forced power of the ASh-82FN engines used in the IL-12. Takeoff power to an altitude of 400 to 500 meters is kept constant. In case of failure by one engine after the IL-14 has achieved a speed of 160 kilometers per hour, when the landing gear is in retracted position, prompt feathering of the propeller will permit continuation of the takeoff.

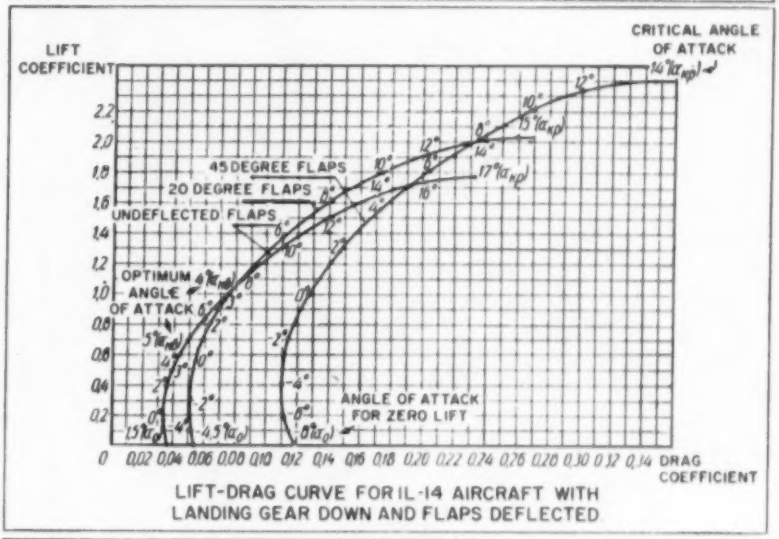
Examination of the flying and operating data on the IL-14 shows that it boasts advantages over other piston powered planes used in civil aviation. The principal advantages are: high cruising speed, safety in takeoff, good single-engine flight characteristics, adequate stability and controllability in all flying regimes, and high payload capacity.

For a detailed acquaintance with the main aerodynamic characteristics of the

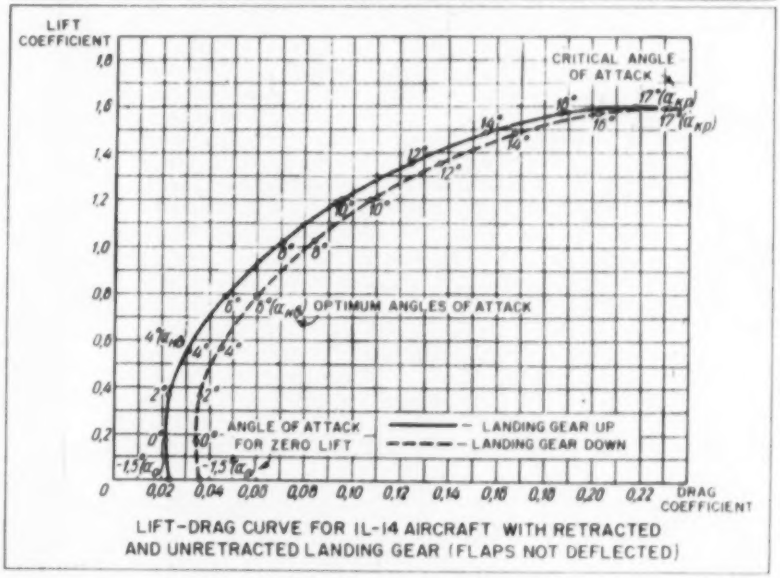
ANGLES OF ATTACK AND AERODYNAMIC EFFICIENCY (LIFT-DRAG RATIO)

ANGLES OF ATTACK IN DEGREES	UNDEFLECTED FLAPS	20 DEGREE FLAPS	45 DEGREE FLAPS
−8	—	—	0
−6	—	—	1,7
−4	—	1,9	3,79
−2	—	6,3	6,4
0	5,28	10,4	7,9
2	11,3	12,7	8,8
4	13,96	13,2 *)	9,2 *)
5	14,3 *)	12,8	9,1
6	13,8	12,6	8,9
8	13,2	11,5	8,64
10	11,9	10,4	8,3
12	10,8	9,5	7,8
14	9,7	8,5	6,95
17	7,8	—	—

* OPTIMUM ANGLES OF ATTACK



LIFT-DRAG CURVE FOR IL-14 AIRCRAFT WITH LANDING GEAR DOWN AND FLAPS DEFLECTED

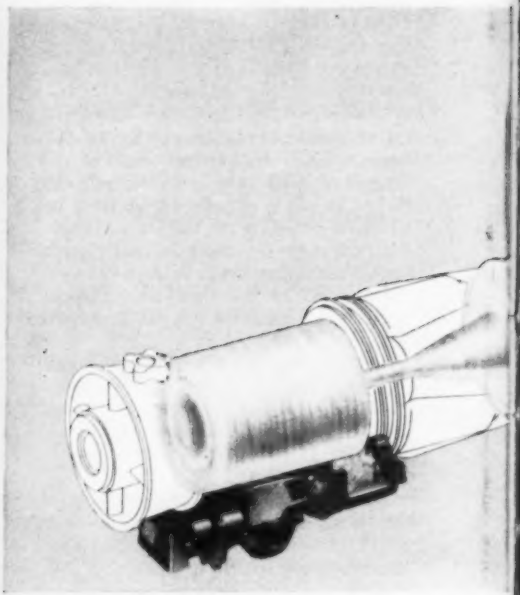


LIFT-DRAG CURVE FOR IL-14 AIRCRAFT WITH RETRACTED AND UNRETRACTED LANDING GEAR (FLAPS NOT DEFLECTED)

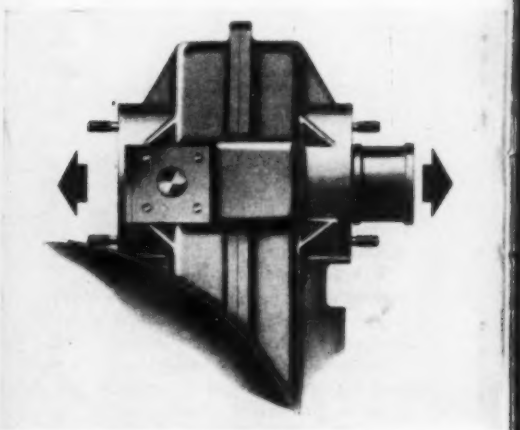
Here's Why General Electric's New

BEST POWERPLANT

NOW BEING FLIGHT-TESTED in a modified Sikorsky S-58 helicopter, two T58 engines deliver more than 2000 horsepower, yet weigh only 650 pounds.



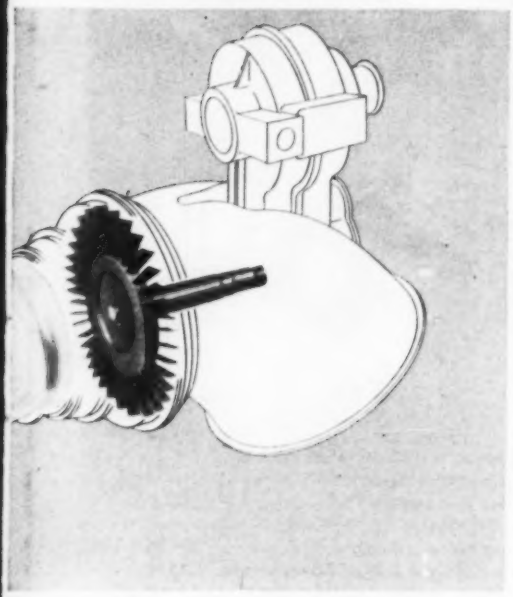
T58'S ADVANCED CONTROLS, FREE TURBINE DESIGN help simplify pilot duty; allow the



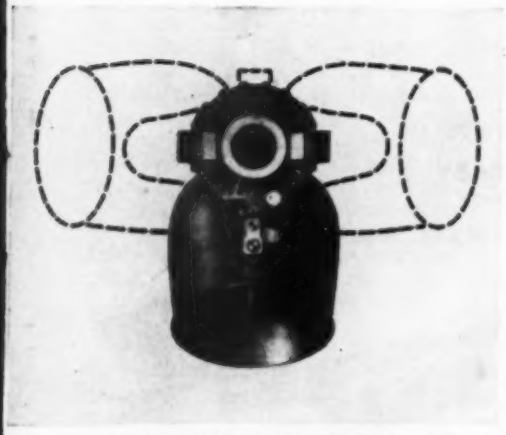
T58'S MAIN REDUCTION GEAR permits convenient fore or aft power extraction.

T58 Turboshaft Engine Is The

FOR HELICOPTERS



helicopter rotor to operate at best speeds for climb, cruise, or hover conditions.



T58'S 3-POSITION EXHAUST NOZZLE mounts vertically or at 90-degree angles.

Offers unmatched performance capability; advanced mechanical design features

Over 3:1 Power-to-weight Ratio—Packing more power per pound than any other gas turbine engine of comparable output, the T58 delivers 1024 horsepower yet weighs only 325 pounds (including 75-lb reduction gear). What will the T58's low weight mean to future helicopters? Drastic reductions in their gross weight—up to 40% faster cruising speeds—greater endurance—and vastly increased ton-mile capacity. In addition, the T58's advanced aerodynamic and lightweight mechanical design promises the same high reliability that has been *proven* in G.E.'s J47, J73, and supersonic J79 jet engines.

0.69 Specific Fuel Consumption (normal, with gear)—The T58's turbine inlet temperatures, pressure ratios and the aerodynamic design of its major components have been balanced to provide the highest possible operating efficiency over a wide range of helicopter flight conditions. Result: a *proven SFC* that rivals the piston engine for economical operation.

Automatic Rotor Speed Control—The T58's revolutionary new constant-speed control eliminates the need for speed adjustments by the pilot during normal flight operation. Combined with the T58's free power turbine, this new control automatically regulates engine output to meet changes in load or flight attitude, thus permitting the helicopter rotor to operate at the most efficient speeds for take-off, climb, cruise and hover.

Small Envelope Size—Measuring only 59 inches long by 16 inches at maximum flange, the T58 makes possible more compact engine compartment design, additional cargo space.

Versatile Exhaust & Power Take-off Arrangement—The engine's 3-position exhaust and fore or aft power take-off arrangement also simplify problems of designing or retrofitting engine compartments in either single- or multi-engine helicopters.

The T58 was developed for the Navy by General Electric's Small Aircraft Engine Dept. General Electric believes the T58's many features make it the best engine of its kind to transform the role and performance of helicopters into new levels of military and commercial usefulness. For detailed performance data, call your local G-E Aviation & Defense Industries Sales Office, or write: General Electric Co., Section 233-5, Schenectady 5, New York, for T58 brochure.

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Imagination!

. . . fired by an atmosphere of enthusiasm and progress, is reflected in the all-new B-58—latest achievement of the team of engineers and scientists at CONVAIR-*FORT WORTH*, America's first supersonic bomber, and another "first" from Convair. But for the scientist and the engineer at CONVAIR-*FORT WORTH*, still newer and more stimulating projects await his imagination and ingenuity in the nearly half-a-hundred Air Force contracts now on hand. He feels confident of success, for there is a wealth of talent to complement his efforts, and no lack of technical facilities to expedite his work.

And there is more, for his family enjoys a mild climate year 'round, countless recreational facilities, modern metropolitan educational and cultural benefits. The cost of living is low, and there's no state sales or income tax, which means his money goes further . . . that's *important*, too!

You're invited to investigate the opportunity awaiting *you* at CONVAIR-*FORT WORTH*. Your inquiry is confidential, of course.

TODAY... **write, wire or telephone PErshing 8-7311**

MR. H. A. BODLEY

Engineering Personnel Dept. 6

CONVAIR-FORT WORTH, TEXAS

CONVAIR

C-V FORT WORTH GD

CONVAIR—A DIVISION OF GENERAL DYNAMICS CORPORATION

IL-14 we will examine the plane's lift-drag curve with retracted landing gear and undeflected flaps (p. 65) in gliding regime with negligible thrust.

As is evident, the following aerodynamic data correspond to the plane's characteristic angles of attack. The angle of attack for zero lift (a_0) is 1.5 degrees. At the same time, the coefficient of lift (C_y) is zero, and the magnitude of the coefficient of drag (C_x) is 0.023. The angle of attack which corresponds to the minimum coefficient of drag, that is, the flight regime at maximum speed, is 0.6 degrees, and the magnitude of the minimum coefficient of drag is 0.021.

Coefficient

It should be mentioned that the coefficient of minimum drag is an index of a plane's aerodynamic efficiency. For the IL-14, its magnitude is comparatively small. Thus, for the Yak-12 (single-engine trainer—Adam) the minimum coefficient of drag is three times greater.

The optimum angle of attack for the IL-14 ($d_{вв}$) ($d_{вв}$ in illustration p. 65) is 4 degrees. At this angle the aerodynamic efficiency (lift-drag ratio) has the greatest magnitude—18.1.

The critical angle of attack ($d_{кр}$) is 17 degrees. The maximum value of the coefficient of lift in the given instance is 1.6.

For the IL-14 as compared with the IL-12, the magnitude of the optimum angle of attack is 2 degrees less, the aerodynamic efficiency is three units greater, the range of angles of attack is 1 degree greater, and the maximum magnitude of lift coefficient at the critical angle of attack is greater.

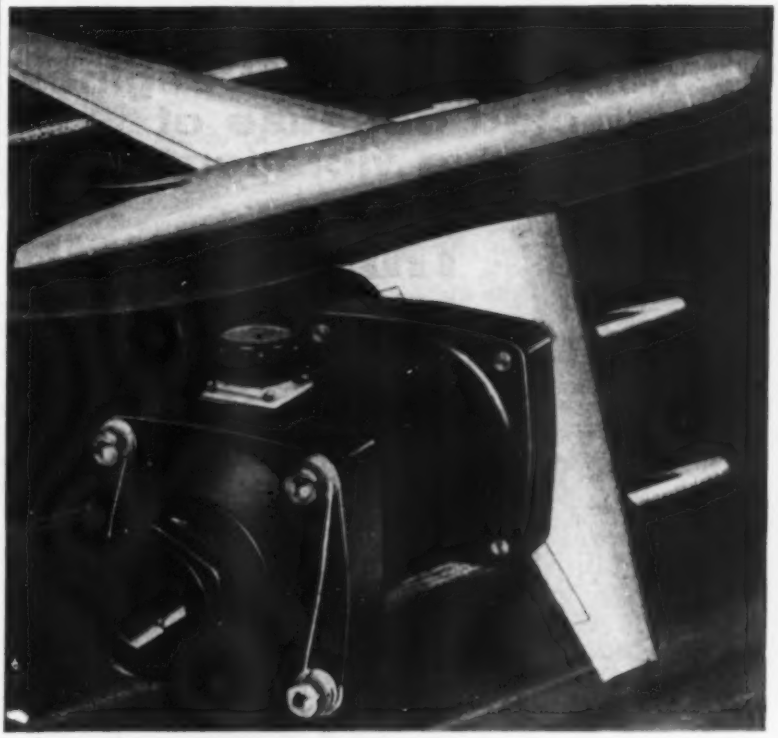
What advantages do these indices give to the airplane?

In flight, with retracted landing gear and undeflected flaps, the IL-14 has a greater range of speeds, less required thrust and power, etc.

We will examine the characteristics of the IL-14 in flight with extended landing gear and deflected flaps (p. 65). The drag coefficient for the IL-14 with extension of the landing gear increases by a magnitude of 0.013 (for the IL-12 by 0.024). Such a small increase is explained by the fact that after the landing gear is extended, the compartments are closed by doors. As a result, the plane's aerodynamic efficiency, with extended landing gear, for the entire range of angles of attack (speeds) is more than for the IL-12.

With deflection of the wing flaps, the profile curve is increased, the air stream breakup is delayed, and the wing's airflow is improved. At the same time, the value of the lift coefficient increases, but simultaneously in still greater degree the drag coefficient increases, and thus the plane's aero-

PIONEERING is our business



NEW BENDIX TRUE MASS FUEL FLOW SYSTEM APPLIES ANGULAR MOMENTUM PRINCIPLE WITH SINGLE TURBINE

Increased accuracy and greater reliability are the two big advantages of the new Bendix *Single-Turbine* Mass Fuel Flow Transmitter designed for systems application in both single- and multiple-engine jet aircraft. (Type 9151 Transmitter is shown above).

The accuracy of the Single-Turbine Type Mass Fuel Flow Transmitter is *within 1% of actual flow*, regardless of flow rate, type of fuel, or environmental conditions. The new, single turbine is responsible for this greater accuracy because of its reduced friction, reduced fluid coupling, and insensitivity to aircraft accelerations.

The simplified design and fewer parts of this Bendix angular momentum transmitter also make possible longer, more trouble-free service life, and *its use to measure flow in either direction*.

Other advantages: low pressure drop, light weight, available in a variety of flow ranges to fit the application.

While this transmitter is new, it fits into a variety of systems—both new and old. Ask us for publication No. 56-217. PIONEER-CENTRAL DIVISION, BENDIX AVIATION CORPORATION, DAVENPORT, IOWA.

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Pioneer-Central Division

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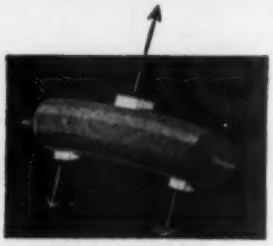
Why are 1 out of 5 new or rebuilt jet engines rejected because of excessive vibration?

THE ANSWER IS BASIC:

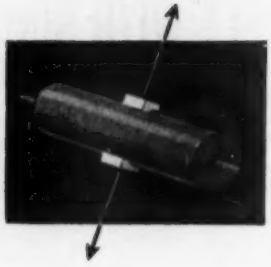
Jet engines are flexible rotors which must be dynamically balanced at operating speed for . . .

PILOT SAFETY
TROUBLE-FREE OPERATION
LOW MAINTENANCE
SMOOTH PERFORMANCE

A rotor that is dynamically balanced at 1000 rpm . . .



can cause dangerous bending moments at 10,000 rpm.



A rotor balanced at operating speed, (10,000 rpm.), exerts no bending moment and remains in dynamic balance.

The IRD-Hicks Model 5000 Horizontal Spin Test Unit . . . in one operation . . . combines over-speed testing and dynamic balancing at actual rotational speed. We invite your inquiry. For further information, write or call International Research & Development Corp., 897 Thomas Lane, Columbus 16, Ohio.

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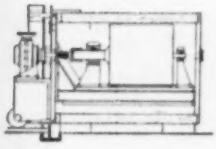

- Vertical High-Speed Spin-Test Equipment
- Ultra High-Speed Centrifuges
- High-Speed Dynamic Balancing Equipment

dynamic efficiency decreases at all angles of attack. For landing, the flaps are deflected an average of 25 to 30 degrees. Their full angle of deflection is 45 degrees.

Shown in illustration p. 65 is the lift-drag curve of the IL-14 with extended landing gear and flaps deflected at 20 and 45 degrees. In addition, the corresponding data are cited in table.

Range Rises

Thus by deflecting the flaps 20 degrees, the angle of attack of zero lift is decreased to minus 4.5 degrees, the optimum angle of attack is 4 degrees, and the efficiency drops to 13.2. The critical angle of attack decreases to 15 degrees, but the lift coefficient increases by 0.26 and is 2.03 instead of 1.77. The range of angles of attack from zero to critical rises and is 19.5 degrees (− 4.5 + + 15). Correspondingly, the plane's range of speeds rises.

On takeoff with flaps deflected 20 degrees, the speed of leaving the ground (145 kilometers per hour) decreases due to the increase in lift coefficient. In addition, the takeoff characteristics improve because, for angles of attack corresponding to speeds from starting takeoff to 170-180 kilometers per hour, the plane's efficiency with flaps deflected 20 degrees is greater than with undeflected flaps.

When the flaps are deflected 45 degrees, still greater changes take place in the IL-14's aerodynamic characteristics, namely: the angle of zero lift decreases to minus 8 degrees; the optimum angle of attack is 4 degrees with simultaneous lowering of the aerodynamic efficiency to 9.2; the critical angle of attack decreases by 3 degrees but the maximum lift coefficient increases by 0.52; and the range of angles of attack from the angle of zero lift to critical rises and is 22 degrees. Correspondingly, the plane's range of speeds increases. From the lift-drag curve it is evident that the aerodynamic efficiency at all angles of attack decreases since with deflection of the flaps 45 degrees the coefficients of lift rise in lesser degree than the coefficients of drag.

The decrease in aerodynamic efficiency is accompanied by an increase in glide angle in landing. The lift coefficient for the landing angle of attack rises, which provides a decrease in landing speed; and the drag coefficient rises, leading to faster loss of speed after reducing the engine power for landing. Consequently, deflecting the flaps while gliding increases its steepness and lowers the speed faster before landing. Whereupon the landing speed itself decreases and, thereby, the length of the landing run also.

The IL-14 lands at a speed of 135 kilometers per hour with flaps deflected 45 degrees. Landing speed with undeflected flaps is 145 kilometers per hour.

In the event of violent head winds or of strong side winds, it is recommended that the landing be made without flaps or deflect them 20 degrees.

Two German Sites Chosen As Nike Missile Bases

Bonn—Two bases for the air defense missile Nike will be built in Ebernberg near Landau and in Baumholder. Allied plans, not yet finalized, also provide for rocket bases near Bad Kreuznach and Simmern. All four bases are in German Rhineland-Palatinate.

Northrop Establishes International Division

Hawthorne, Calif.—Northrop Aircraft, Inc., has established a new division known as Northrop International which will be responsible for all overseas programs of the company.

J. Gilbert Nebleton Jr., formerly vice president customer relations for the Radioplane Co., was elected corporate vice president responsible for the new division.

His offices will be at 9756 Wilshire Blvd., Beverly Hills, the new corporate headquarters after May 1.

SAC
Silver Jubilee Newsreel
by JACK PATTON
PLANE PEOPLE
FILLERUP ? PILOTS ARE TOO SKINNY WHERE ARE THE PISTONS ?
'36---REFUELLER KILLY KILLINGSWORTH, EX-DIETICIAN LORRAINE SANDERS, ENGINEMAN LOUIS BEIMER START HERE.
HA---PI OVER X PLUS Y EQUALS SERVICE!
'37 WINSTON CASTLEBERRY JOINED FIRM, RECOMMENDED MORE EMPHASIS ON SERVICE.
CAN YOU BUILD 'EM, TOO ? DUNNO-NEVER TRIED!
'39-40...FIRST IN U.S. AS AUTHORIZED LOCKHEED SERVICE STATION.
RECKON IT'LL SPIN? I'M SICK!
AMONG LOCKHEED 10 OWNERS WAS DOCTOR WHOSE PILOT ALSO CREWED HIS YACHT.
THE BIG UNS
Southwest Airmotive was among the few companies in America providing complete service for business flying's first "big uns", like (top to bottom) the Boeing 247, and the Tri-Motor Ford.
LOCKHEED LEADER
A look at the records shows that SAC has pioneered more important Lockheed business aircraft modifications than any single firm in America. Besides being tops with other types, we're still No. 1 as a leader in Lockheeds.
1932 A QUARTER CENTURY OF LEADERSHIP 1957
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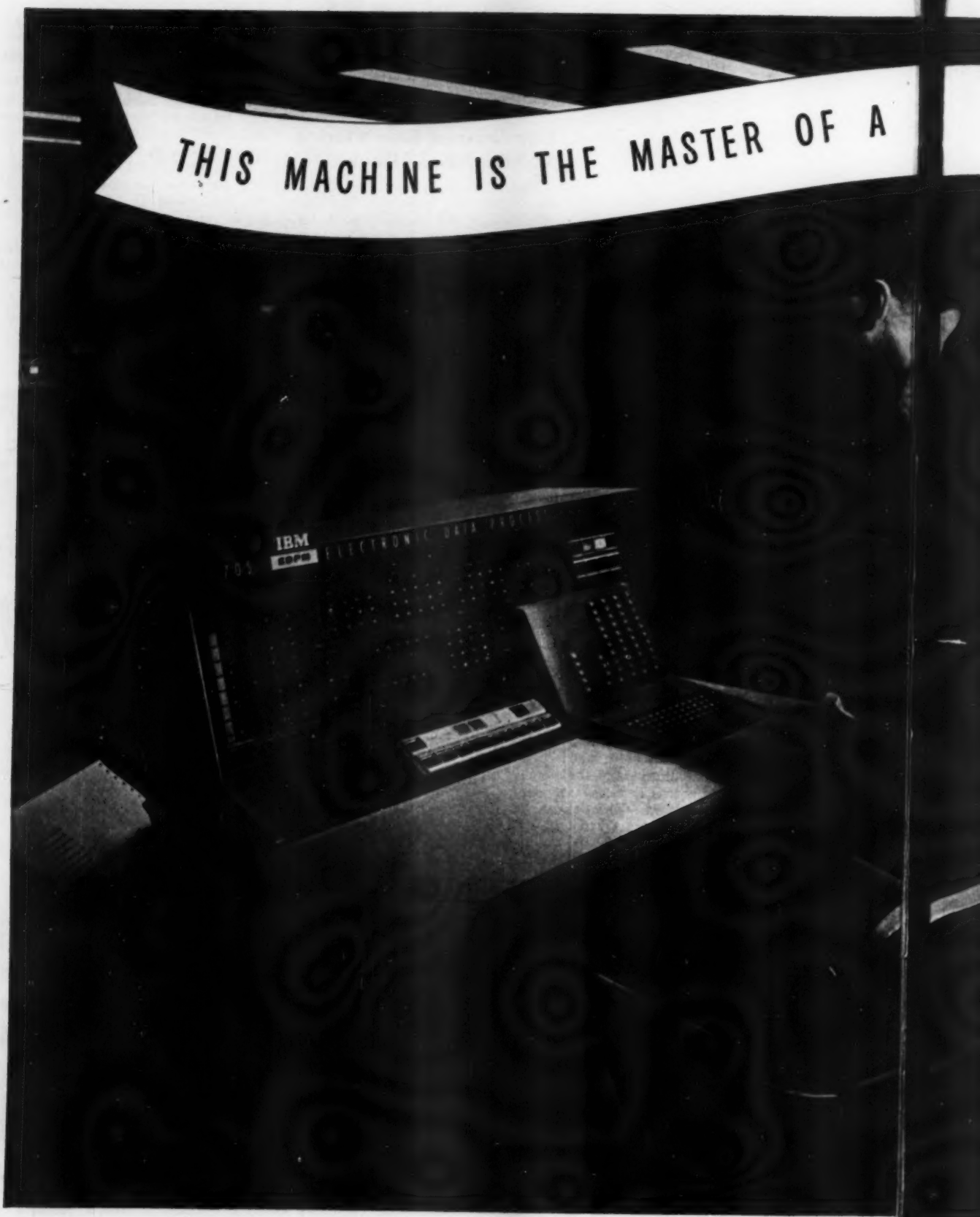
THIS MACHINE IS THE MASTER OF A
IBM

FLEET OF JETS

The time is drawing near when Pan American will inaugurate commercial jet service. But even now, with the aid of Pan Am's IBM 705 electronic data-processing center, the jets are already "flying."

The fabulous 705 simulates jet-age operations along Pan Am's 64,085 world-wide route miles—right now. Magnetic tapes feed into the electronic wizard such information as distance between cities, cruising speeds, altitudes, wind velocities, airport elevations, runway lengths, fuel prices and dozens of other variables—and out come the crucial figures on revenue ton-mile costs, in 120-column tabulations.

With this computer the key characteristics of any plane in production or on the drawing boards can be projected in minutes against actual operating conditions. The characteristics of the Boeing Jet Clipper*, for instance, can be described on 69 IBM punch cards.

But the 705 has present-day applications as well.

In its 'round-the-world operations, Pan American, in an average working day, handles 10,000 reservations. They are translated into not just ordinary stubs but intricate flight coupons that often encompass the globe and involve as many as 50 flight segments on as many carriers. The paper work can be imagined in terms of 15 million standard tabulating cards—with the 705 their information can be contained on a dozen magnetic tape reels, 10½ inches in diameter.

This machine, the first of its kind to be operating in the transportation field, has been installed in Pan Am's Long Island City offices. The 705 is on a full 24-hour-a-day schedule grinding out information otherwise physically impractical to obtain. The electronic brain keeps a sensitive finger on movements of international trade as reflected in the flow of passengers and cargo . . . speeds billing . . . handles payrolls . . . provides precise control of inventory . . . and, of course, manages accounting paper work.

Operations, maintenance, purchasing, training are all teaming up to meet the challenge of the jet age. This kind of teamwork is typical of Pan American's pioneering role in aviation—past, present and future. Determined to make the transition to the jets a smooth one for the public and the industry alike, Pan American *will be ready* when the first jet Clippers are delivered.

*Trade-Mark, Reg. U.S. Pat. Off.

The first responsibility of an airline is to be a *useful* citizen.

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MEMBER: A. V. ROE CANADA LIMITED & THE HAWKER SIDDELEY GROUP

Navy Airplanes Show Good Availability

By Richard Sweeney

El Centro, Calif.—High order of reliability of fleet-use airplanes, especially in ordnance and avionics, was apparent during Navy weapons meet here.

Predominant problem was foreign object damage to Curtiss-Wright J65 turbojet engines in North American FJ-3 Fury fighters during landing and takeoff despite cleaning of active runways. Clean taxiways, ramp areas, use of intake screens, reduced foreign object damage considerably, but landing-takeoff situation remained biggest headache.

Using Aero 5A and Aero 5D fire control systems on Grumman F9F-5 and F9F-8 respectively, and the Mk. 16 system on the FJ-3, all utilizing the APG-30 ranging radar, competing squadrons were operating proven equipment. Avionic problems were few and random, none unexpected.

Mk. III 20 mm. cannons were used in F9F airplanes, Mk. 12 guns in the FJ-3. Guns are identical in basic operation, prime difference being an air feeder for the Mk. III, a windup feeder for the Mk. 12.

Supplies Materiel

Fleet Air Gunnery Unit (FAGU), based at El Centro Naval Auxiliary Air Station, provided all support materiel for units competing in the meet, furnished towed targets and pilots, and supported airplanes involved in firepower demonstrations. Competing squadron maintenance personnel did all actual work on aircraft, drawing needed equipment replacement items from FAGU stock. FAGU supply officers drew approximately 30-day normal supply of spares, which were expected to be consumed within the projected seven firing days of the meet.

Overall, aircraft were firing better than 93% of loaded ordnance per mission. Target hits also were running to numbers indicating good quality marksmanship of pilots.

Eight Navy squadrons and three Marine squadrons participated in the competition, in which units either competed in air-to-air or air-to-ground phases, but not both. Of these, four Navy units and two Marine units competed in aerial gunnery while four Navy and one Marine unit competed in air-to-ground gunnery and bombing.

In air-to-air gunnery, three Navy units, two from Miramar and one from Oceana, flew FJ-3s; one Navy unit from Jacksonville flew F9F-8s; one Marine unit from Cherry Point flew F9F-8s, and one Marine unit from El Toro flew F9F-5s.

In air-to-ground gunnery and bombing, one Navy unit from Jacksonville flew AD-6s, another Navy squadron from Jacksonville flew F9F-8s, one Marine unit from Edenton flew ADs, and two Navy squadrons from Moffett flew ADs and F9F-8s.

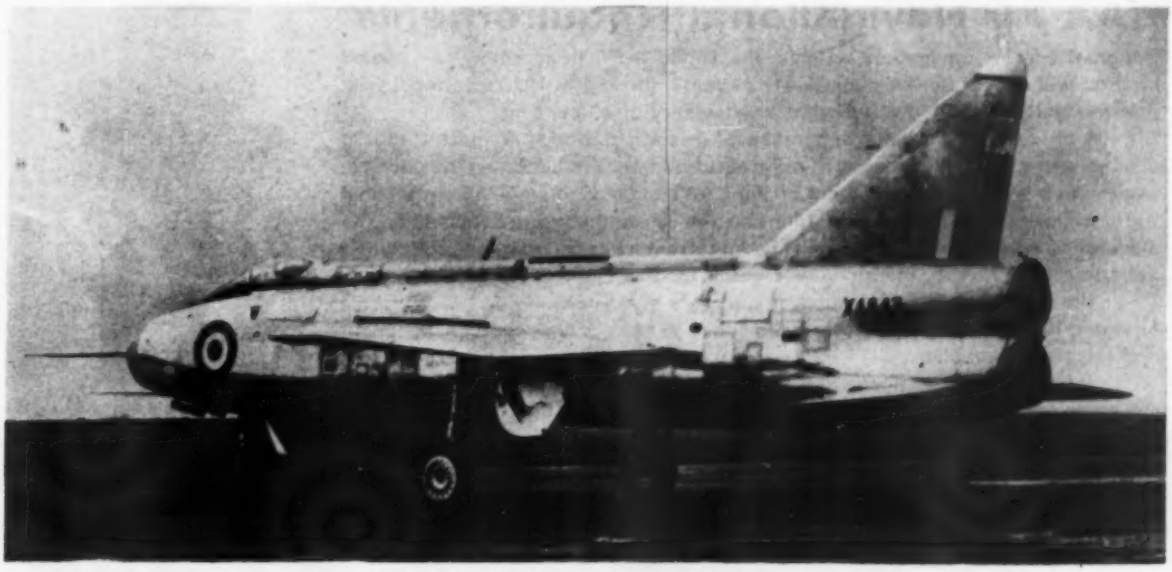
Mixture of Navy and Marine units, various types of both jet and prop driven aircraft, gave indication of wide scope on combat potential in all classifications.

Demonstrations

During meet, daily firepower demonstrations were held, including first public displays of Navy LABS using Chance Vought F7U Cutlass. First displays of Navy LABS system were made during press cruise of USS Forrestal, but at that time, Grumman F9F-8s were used. This was first indication that F7U has atomic capability.

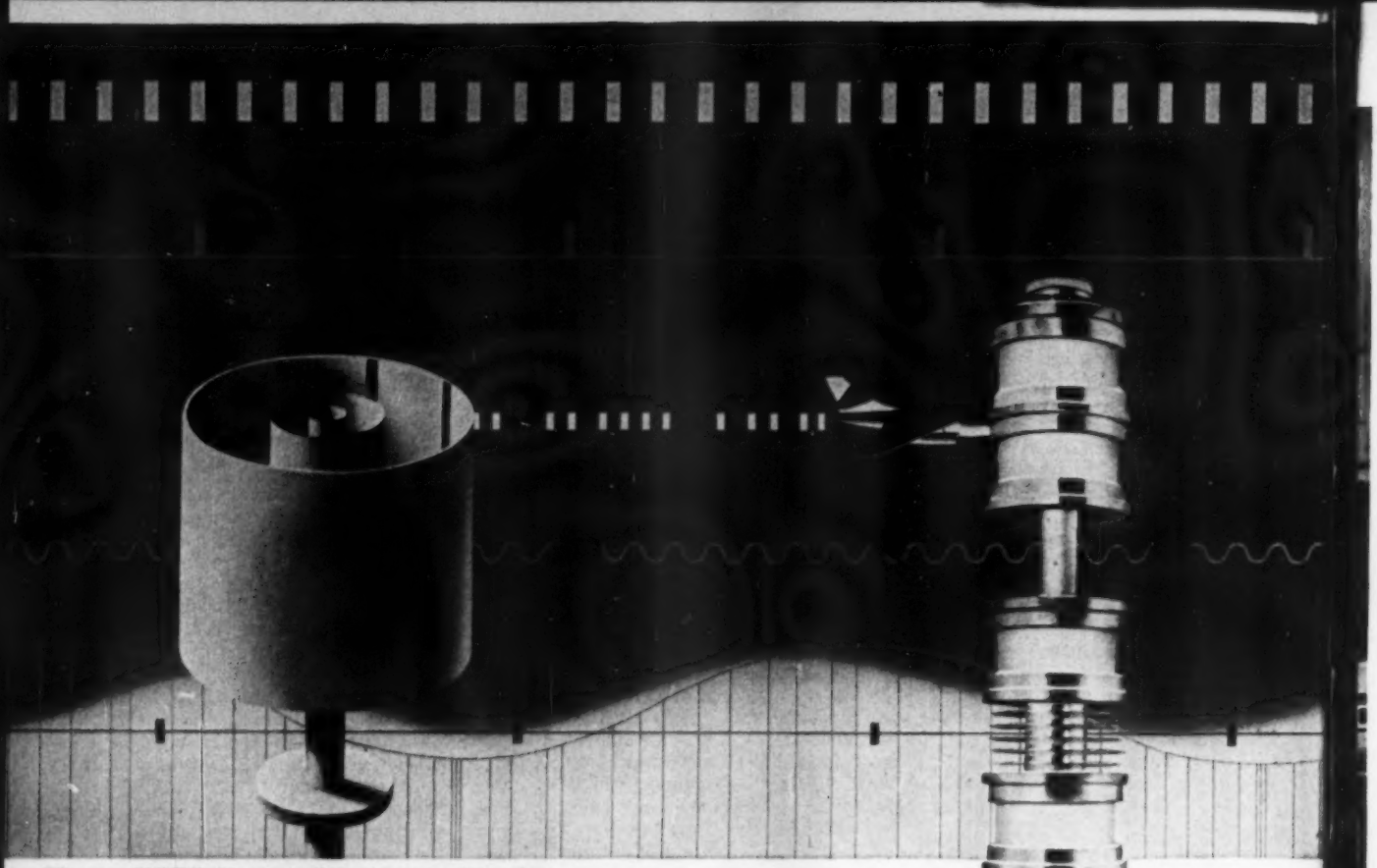
Other demonstrations:

- **Second public** firing of Navy's large Zuni rocket (AW Mar. 11, p. 26).
- **Salvo firing** of 194 2.75-in. rockets air-to-ground by prop driven AD Skyraiders.
- **Firing** of multiple external stores (rockets, "special shapes"), by McDonnell F3H-2N Banshee.
- **Aerial display** for of new Westinghouse Aero 13F (all weather) fire con-



P.1B Makes First Flight

English Electric P.1B twin jet fighter made its first flight only a week after British announced defense policy changes which will shorten its production life. It will be last fighter British will build. Air defense missiles will succeed manned fighters, according to British policy (AW April 15, p. 27). Powered by two Rolls-Royce Avon engines, P.1B is first British fighter supersonic in level flight. Fuselage was redesigned to accommodate more powerful Avon engines (P.1A had Sapphire) and radio, radar and armament, including missiles and 30 mm. Aden cannon. Cockpit, equipment is cooled to overcome kinetic heating effects of high speeds. P.1B is all weather day and night fighter, was high rate of climb, can cruise economically on one engine.



Eimac X676 Modulating Anode Klystron

Eimac X676 Meets CAA Air Navigational Requirements

Designed for air navigation systems, the Eimac X676 three cavity, air cooled klystron will deliver 30 KW peak power output in the 955 to 1220 mc range. With a power gain of 35 db, this tube has an efficiency of 40 per cent.

A typical air navigation systems requirement is a shaped RF pulse output to eliminate spectrum interference in adjacent channels. The Eimac X676 conservatively meets the 60db requirement of the CAA's air navigational system without using critically tuned, expensive filters in the RF output transmission line. The modulating anode permits pulsing the beam current while keeping the accelerating voltage constant. Also, the modulator circuit for this application is quite simple.

The RF cavities are external to the vacuum system and detachable from the klystron. The user may purchase spare tubes without buying additional tuning and focusing assemblies.

For the design engineer, the features of the X676 simplify circuitry—for the equipment operators the X676 provides reliable, long-lived performance at moderate cost.

For further information about the Eimac X676 Modulating Anode Klystron, consult our Application Engineering Department. Also available are two highly informative booklets; "The Care and Feeding of Klystrons" and "Klystron Facts . . . Case Four".

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***Eimac First* in high power amplifier klystrons**

Typical Pulse Operation X676

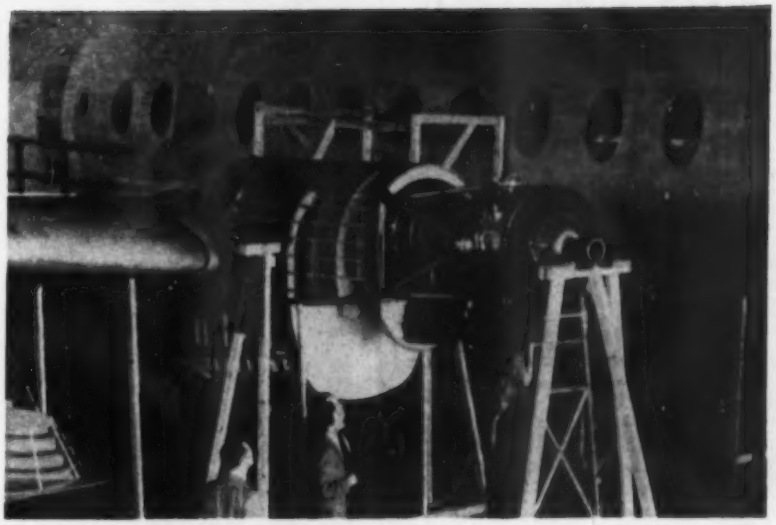
DC Beam Voltage	24 KV	Power Output	32 KW	Power Gain	35 db
DC Beam Current	3.3 Amps	Driving Power	10 watts	Average Power	1 KW
Power Input	80 KW	Efficiency	40%		

trol system in Douglas F4D Skyrays. Skyrays were flown by Naval Test Center pilots from Patuxent River, who went "under the hood" shortly after takeoff, accomplished remainder of mission through firing passes blind.

Aero 13F is not yet in fleet use on F4D but was designed for incorporation on retrofit basis on Skyrays now in fleet and Marine use. System is packaged so that mounting is on rail in the circular nose of F4D, enabling maintenance to be performed by simply removing the plane's nose cone, sliding out avionic gear on the rail.

• **First use** of newly developed special explosive charge which yields mushroom cloud, loud noise and sprays dirt about simulating fallout, like a tactical atomic bomb. Two were to be set off during meet, one during a firepower demonstration on gunnery range, other close to El Centro base itself. Developed by Bermite Powder Co., Saugus, Calif., charge was planned to familiarize Navy personnel on land bases and ship board to physical characteristics of tactical nuclear weapons, without danger of radioactivity.

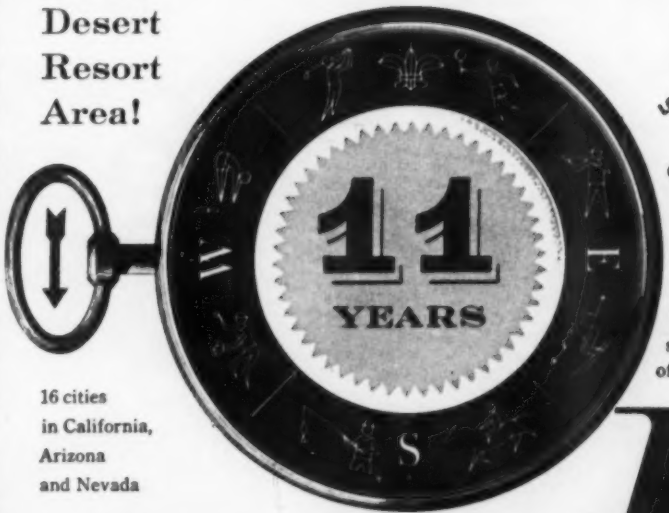
Ground rules of weapons meet, second such staged by Navy and with twice the number of competing units and expanded events (last year's consisted of only aerial gunnery) were similar to those of recent Third Marine Air Wing meet (AW, Mar. 25, p. 33), in that only unit personnel could touch competing planes and once a competing plane broke ground on takeoff, it was commited and charged for the mission regardless of the cause if an abort occurred in aircraft, avionics or ordnance.



Mockup on Tyne Vanguard

Trans-Canada Air Lines engineers inspect a mockup of the Rolls-Royce Tyne turboprop being installed in the starboard inner nacelle of the full-scale Vickers Vanguard mockup at Weybridge, England. Engine, rated at 5,315 eshp., is scheduled for Vanguards on order for Trans-Canada Air Lines, with delivery scheduled to start in 1960.

Serving America's Great Desert Resort Area!



16 cities in California, Arizona and Nevada

One measure of America's aviation progress is Bonanza Air Lines' eleven-year record of growth. Bonanza has kept pace with the expansion of the West, and by this time next year a new fleet of Silver Dart F-27 turbojet aircraft will be in service. Faster flights and better schedules will continue to be hallmarks of the Bonanza Air Lines' system.

BONANZA AIR LINES

CHR Silicone Rubber NEWS

CHR has a new low durometer silicone rubber

Higher tear strength, lower compression set than any previous low durometer stock.

The new COHRlastic R-11568 with softness in the range of sponge is now available in custom sheets and moldings. This 25 durometer silicone rubber has high tensile, elongation and tear strength, unusually low compression set, −100° F to 480° F flexible temperature range.

Write for bulletin on CHR's soft sealing material which gives basic facts on new R-11568, compares it with silicone sponge rubber and silicone foam rubber (COHRfoam).

Send ..... copies of bulletin on soft sealing materials.

☐ Include CHR Stock Item folder & price list.

☐ Include CHR Coated Fabric bulletin.

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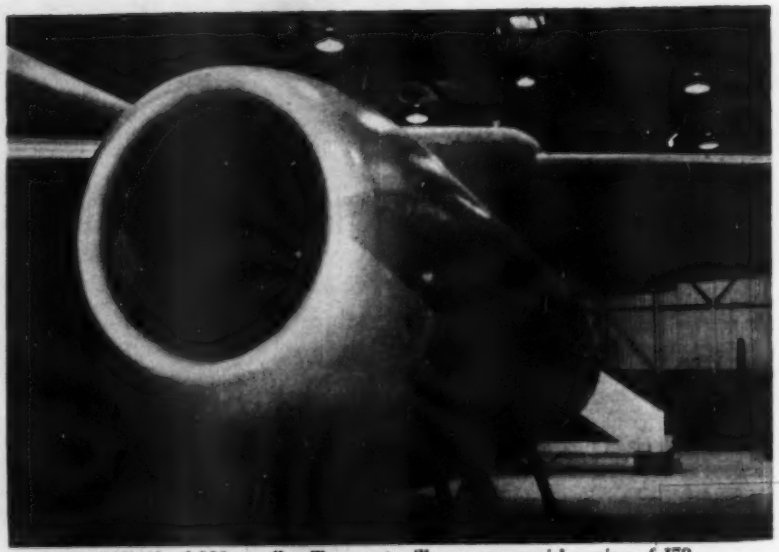


MOCKUP DETAIL of 880 nacelle. Transport will use commercial version of J79.

Convair 880 Details

DOUBLE-SLOTTED Fowler-type flaps, shown on 880 mockup, will be used.

WING JIG components for Convair 880 are for actual structure. Base units seen in background have the main spar pods installed.

Boeing 707 Intercontinental—drawing courtesy Boeing Airplane Co.

CHR's high tear strength silicone rubber picked for 707's major door and window seals

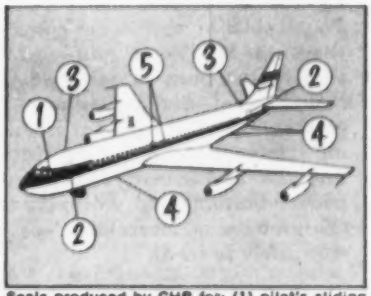
These seals, produced by CHR, will resist tear, abrasion, compression set, weathering, sticking, —100°F. to 400°F.

All present versions of the Boeing 707 will have silicone rubber door, window and hatch seals in the important traffic areas. The speeds, altitudes and temperatures to be encountered by the 707s would soon render organic rubber seals useless in working areas such as the pilot's sliding window, the passenger, cargo and galley doors where silicone rubber is to be used.

It is significant that the seals for these areas will be produced by CHR with compounds meeting Boeing's BMS 1-22 specification. This specification and AMS 3345 and 3346 were written around CHR's COHRlastic HT* high tear strength silicone rubber compounds. These CHR compounds, at the present, are the *only* stocks which will meet these specifications.

In the single year that these compounds have been available, a trend to designing with high tear strength silicone rubber has been established. Other airframe and engine companies are writing specs around CHR's compounds or specifying AMS 3345 and 3346 on new and revised prints.

CHR representatives calling on all major airframe and engine manufacturers are available for consultation on use of these compounds. Write or phone for specifications and samples of COHRlastic HT silicone rubber.



Seals produced by CHR for: (1) pilot's sliding window (2) passenger door (3) galley door (4) cargo hatch and (5) escape hatch are made with CHR's COHRlastic HT 666 silicone rubber meeting Boeing's BMS 1-22 specification. Other CHR silicone rubber seals are used throughout all 707 models.

*COHRlastic HT 665 and HT 666 are produced from high molecular weight gums reinforced with du Pont's Valron® esterail.

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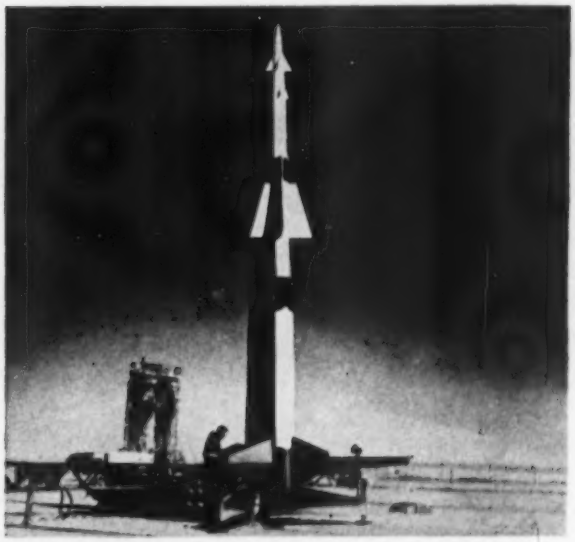
The first men on the moon

What Douglas engineers are doing to make it possible!

Space travel, a dream five years ago, is now so near reality that lunar landings are predicted by the end of this century.

This is hastened by knowledge being gained in *present* and *practical* research. For instance, when Douglas engineers find new ways for fliers to survive high gravitational pulls at supersonic speeds, they also help some future pilot survive the blast-off of a moon-bound rocket. And current studies on heat dispersion, aimed at getting an intercontinental missile back into our atmosphere without air friction burning it up, will apply to the problem of returning a space ship safely to earth.

With the possibility of interplanetary flight accepted by engineers, man now looks to outer space and is speculating on new power sources needed to get him there. A predicted break-through is the plasma engine, which will harness ions or light itself to drive aircraft nearly 186,000 miles per second.



At Douglas, a Missiles Division with the longest history in its field, is building rockets and missiles for military use. Nike Ajax (above) is already guarding principal cities, and soon the more potent Nike Hercules will be ready to take over these assignments. Thor, an intermediate range ballistics missile, is undergoing tests, and on the classified list are many other out-of-this-world projects in engineering, design and construction.

Depend on

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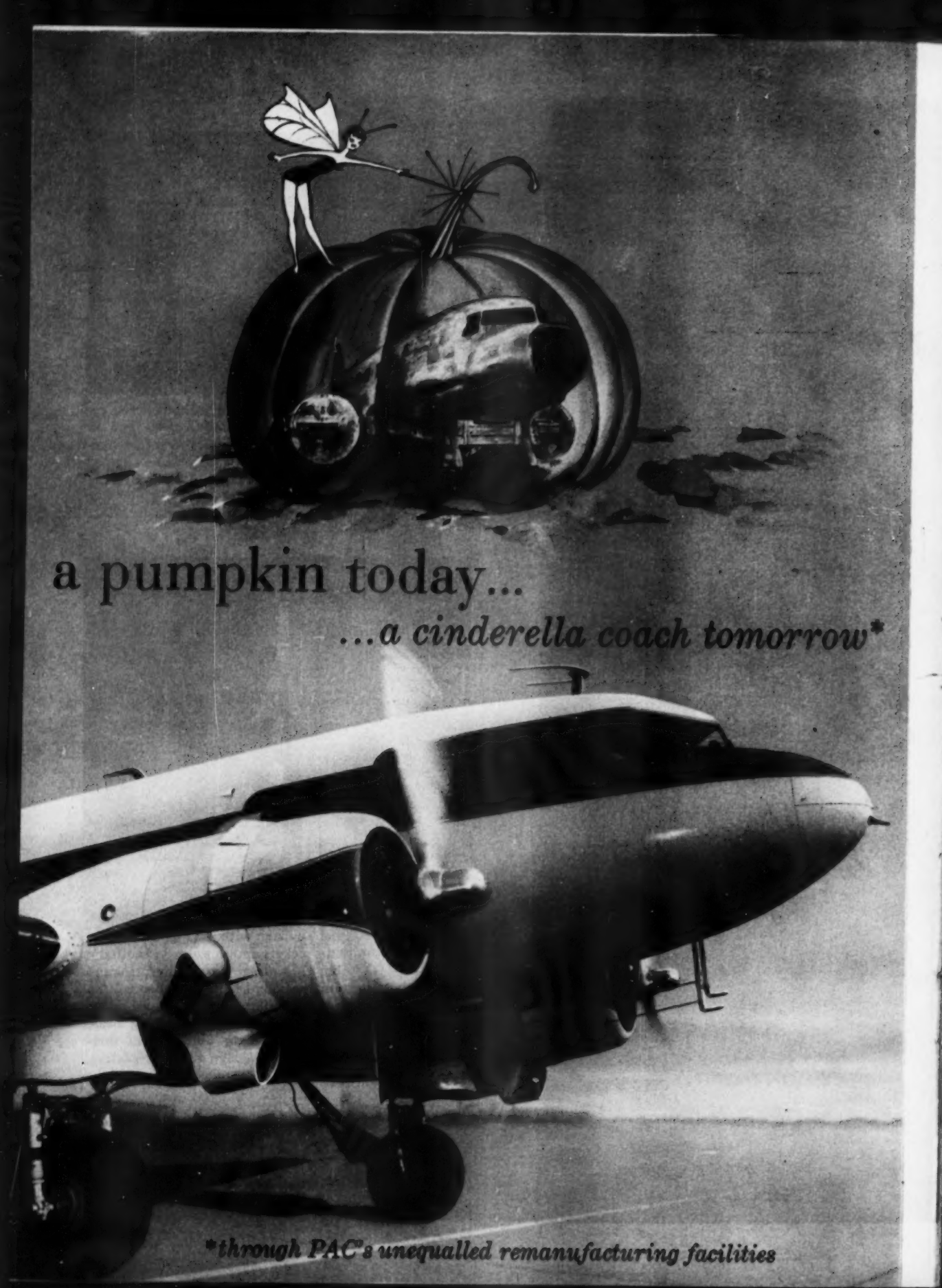
first in Aviation


a pumpkin today...
...a cinderella coach tomorrow*
*through PAC's unequalled remanufacturing facilities

MODIFICATION "MAGIC" BY PACIFIC AIRMOTIVE

Latest achievement of Pacific Airmotive Corporation's Burbank Aircraft Division is the most complete re-manufacture of a DC-3 ever attempted. *Delivered to its new owner in record time*, this executive DC-3 is striking proof that PAC's facilities provide the business aircraft industry with unmatched modification, overhaul and repair service, backed by trained personnel with an unexcelled experience level. Services include complete airframe overhaul and modification for all types of private and commercial aircraft; engine overhaul; interiors; hydraulic systems; radio and radar installation; brakes and accessories. Complete test facilities are provided while production line techniques and full parts inventories speed delivery and reduce costs.

The only "new" DC-3 in the air today—every piece of wire, cable, tubing, every component, all parts and material attached to the basic airframe are factory-new or equivalent.

THE ONLY PRIVATE MAINTENANCE facility on the West Coast currently servicing J-57 engines, PAC is continuing its acknowledged leadership in the engine overhaul field. PAC's "years-ahead" programming will be ready for the new and more powerful engines soon to be in use by both military and commercial services.

PACAERO Engineering Corp., new subsidiary of Pacific Airmotive, continues full production of the world-famous Learstar executive transport, virtually a new aircraft remanufactured from the Lodestar. Improved safety, performance, range and comfort have established the Learstar as the new standard for business aircraft.

AIRLINES have long relied on PAC's services for engine overhaul. Currently, 11 air carriers contract with PAC for this important service—including the Flying Tiger Line and Slick Airways, who look to PAC for overhaul of the R2800-CB engines powering their fleets of DC-6s.

TEST EQUIPMENT designed and manufactured by PAC provides the aircraft industry with a full line of engine and accessory test stands and ground support equipment. Special units have recently been developed for testing jet engines. *Custom design for custom*

PAC's Chino base maintains a full rework and modification program on F-86 aircraft.

requirements is a vital PAC contribution to the aircraft industry. Entirely new types of test and ground support equipment are in production or development for present and future needs of the industry at both the Burbank and Linden, N. J. plants.

AGAIN THIS YEAR PAC will conduct Pratt & Whitney Aircraft Engine Operation and Maintenance Forums. Dates now scheduled are: Denver, May 14; Burbank, May 17; Oakland, May 20; Seattle, May 22. Those desiring to attend are invited to write PAC for reservations and tie-down arrangements.

PAC has available specific information covering the many separate phases of services and products available to aircraft owners and operators. You are invited to write the nearest PAC plant, which will be glad to supply the proper information promptly and without obligation.

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SUBSIDIARY: *PACAERO ENGINEERING CORP.*
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New Rotor and Hub Tested for Bell XV-3

New two-blade rotor and a simplified hub is being tested for Bell's XV-3 tilting rotor convertiplane near Ft. Worth, Dallas. Two-blade semi-rigid rotor, which will replace current three-blade configuration (AW April 15, p. 23), is being evaluated on a whirl test stand by Bell Helicopter Corp. New rotor can be utilized because of improvements in the basic kinamatics of the semi-rigid rotor, according to the company.

A major factor in this design advance is Bell's recently developed underslung feathering axis (UFA) hub, also used on the turbine powered XH-40 and being tested on the Model 47.

Test program, which will include stability and stress investigation on the whirl stand and a 100-hr. approval period, is being started following receipt of a supplemental agreement from USAF, which is administering the XV-3 program for the Army.

A second set of the new rotor system will be installed on the No. 2 Bell XV-3 and the aircraft will be flown by Military Air Transport Service to Palo Alto, Calif., for advanced tests in NACA's 40-ft. x 80-ft. full-scale wind tunnel. Wind tunnel phase will be followed by Phase II flight tests.

C-46 Weight Boost Approval Sought

Miami—L. B. Smith Corp. is seeking Civil Aeronautics Administration approval of a boost in gross takeoff weight of its C-46 modification to a 50,000 lb. airplane. Designated the C-46 CW20-T, it is presently CAA-approved at 47,650 lb.

The Miami firm says a dozen of the modified C-46s now are in operation, seven are undergoing re-manufacture, and several more are on order. Experience has shown, according to L. B. Smith, that the airplane has capabilities for the 50,000-lb. gross. Few changes in present modification are expected to be required.

Riddle airlines last month announced CAA approval of a C-46 modification the cargo carrier has developed at its Miami base (AW Mar. 25, p. 29). Riddle is pushing sales of its "C-46R" modification to short-haul carriers.

If L. B. Smith's new gross is approved, it will top Riddle's by 100 lb.

Other performance figures announced by the firms: 225-mph. cruise speed, 1,635-mi. range, 45-55-passenger capacity for the Smith conversion: 235-mph. top true air speed, 1,600-mi. range, 50-passenger capacity for the Riddle conversion.

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Douglas has the reputation of being an "engineer's outfit," with the three top administrative posts being held by engineers. Maybe that's why it's the biggest, most successful unit in its field. Certainly it offers the engineer unexcelled opportunities in the specialty of *his* choice ... be it related to missiles or commercial or military aircraft.

You've looked around. Now look ahead... and contact Douglas.

For further information about opportunities with Douglas in Santa Monica, El Segundo and Long Beach, California and Tulsa, Oklahoma, write today to:

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First in Aviation

1957

PREPARED BY

AIR TRANSPORT ASSOCIATION OF AMERICA

1107 [illegible] N. W., WASHINGTON, D. C.

The President's Message

THE JOB AHEAD

This book is a record of the past. In these factual and statistical columns you will find a dramatic story of air transport progress. But the men and women of the scheduled airlines, both by inclination and necessity, seldom dwell on the accomplishments of the past. In 1957, the scheduled airlines of the United States stand on the threshold of the civil aviation jet age. This revolution in transportation may well revise drastically the pattern of our economic and political and social life.

So far as the airlines are concerned there is no turning back. By the end of 1956, they had committed themselves to more than $2,600,000,000 to be spent over the next 5 years for new turbo-prop and turbo-jet airliners that will move people and cargo faster, accelerate the mails and add new and more powerful wings to our national defense.

But to bring these benefits to the public, the airlines face new and complex problems, both technological and economic, that have been thrust upon them. At stake is our nation's world leadership in aerial commerce and the very feasibility and vigor of its air power, in peace and war.

Most immediately critical is the problem of air navigation and air traffic control. We have almost run out of a precious natural resource, the air space itself. In addition, the air traffic control system is inadequate to handle even today's air fleet. More radar and other known electronic aids must be employed to provide some interim improvement of the present system. But beyond this, we need a whole new system concept geared to the traffic of tomorrow, that will increase rapidly in numbers and complexity, to provide adequate control of all air traffic at all times. Of course, any modern system must contemplate the unique and elaborate demands of the military and so must be far more expensive than civil aviation alone requires.

Equally important is the need for improvement and development of our nation's airports, those highly valued gateways by which each local community will enter or maintain its position in the air age.

These problems of adequate air traffic control and airport facilities are everybody's for they are concerned with vital service to the nation's air defense, our air transport network, the growing fleets of business aircraft and the private flyers.

The airlines are concentrating on better service for passengers and cargo but they face a serious economic barrier. This problem magnified itself in 1956. For the 19th consecutive year the scheduled airlines set new records for public usefulness. Revenue ton-miles flown—the yardstick by which we measure the usefulness of air transport—increased 15.6 per cent for the entire American-Flag scheduled air transport industry. But even though the industry's total revenues hit an all-time high of $1,861,175,000, an increase of 13.9 per cent above 1955, the net operating income after taxes was 7.2 per cent below 1955 due to continuing rising costs in all phases of airline operation. This steadily narrowing gap between growth and net income means that the airlines are becoming progressively more vulnerable financially.

The grim fact is that constant technological improvements and intensive management efficiency, which built today's vast airline network, are no longer sufficient to combat the inflation trend of our nation's economy. This has focused attention anew on the fare structure of the airlines.

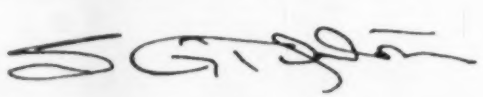
Since the passage of the Civil Aeronautics Act of 1938, the birth certificate of the organized scheduled air transport industry as we know it today, the airlines have maintained a policy of swallowing cost increases to keep fares low. Actually air transportation today costs the air traveler less per mile than it did in 1938. During this same period, while the average fare has been held down, the industry has doubled—and in many instances tripled—its usefulness in every phase of its service to the public.

The revenue problem is complicated by regulation. Scheduled air transport is the most closely regulated and highly competitive public service industry there is and competition is constantly increasing. For instance, new service has been authorized between 320 pairs of cities during the past two years. Further, in the case of 64 city pairs, already served by two, three or four competing airlines, more service was added. Beyond this, at the end of 1956, 33 foreign carriers were flying into this country in direct competition with many of our own carriers for overseas business.

The fare and airline cost problem will be in the spotlight for months to come. One thing is certain—to hold the fare line at the expense of improvements in service is not in the best interest of the public or the air transport industry.

The scheduled airlines also must constantly improve equipment because of their responsibilities to our national security. The airlines feel they can provide an even greater contribution to the national defense than is presently provided for in the Civil Reserve Air Fleet (CRAF) program if they are permitted to perform a greater share of the routine carriage of military personnel and cargo. This will permit the Air Force to devote more of their trained men and resources to such combat activities as SAC and ADC, reduce the over-all load on the taxpayer, and create a greater airlift potential in case of national emergency. These beneficial results can be obtained if a closer working partnership is developed with the military.

The job ahead is to unscramble these problems and face the future with the competence and confidence that have enabled the U. S. scheduled air transport industry to build the largest, finest, fastest and safest air transportation system in the world.



AVIATION WEEK

Air Transport

FACTS AND FIGURES

18th Edition, 1957

This index covers material demonstrating the increasing use of U. S. scheduled air transportation in the post war years. Revised data filed by the scheduled air carriers with the Civil Aeronautics Board and the records of the Interstate Commerce Commission served as the major sources of the statistics.

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Definition of Terms

Passenger Miles and Ton Miles

AVAILABLE SEAT MILES FLOWN. Total seat miles available for sale in scheduled service.

AVAILABLE TON MILES. Total ton miles of lift capacity available for sale in scheduled and charter service.

CHARTER FLIGHT. Transportation of passengers or property on other than scheduled and designated extra section flights.

EXPRESS TON MILE. A ton of express flown one mile.

FREIGHT TON MILE. A ton of freight flown one mile.

PASSENGER MILE. One passenger flown one mile.

PASSENGER LOAD FACTOR. The percentage of available seat miles actually sold in scheduled service.

PASSENGER TON MILES. Passenger miles converted to ton miles. (See definition of revenue ton miles.)

REVENUE PASSENGER MILES. The number of fare paying passengers flown times the length of trip in miles. This is the amount of available seat miles sold.

REVENUE PLANE MILES. Aircraft miles flown in scheduled service.

REVENUE TON MILES. The ton miles sold in scheduled and charter service. In the construction of this traffic measure passenger miles are converted to ton miles on the basis of about 10 to 1. That is, ten passengers with allowable free baggage are accepted as equalling one ton.

SEAT MILE. One passenger seat, filled or unfilled, flown one mile.

TON MILE LOAD FACTOR. Percentage of available ton miles sold in scheduled and charter service.

U. S. MAIL TON MILE. A ton of mail flown one mile. The statistic includes priority air letter mail and air parcel post. Since the beginning of the experiment on flying first-class (three-cent) mail by air, such non-priority mail has also been included in U. S. Mail Ton Miles.

Revenues and Profit and Loss

EXPRESS REVENUE. Revenues accrued from the carriage of express.

FREIGHT REVENUE. Revenues accrued from the carriage of freight.

INCOME TAXES. Federal income taxes.

NET INCOME BEFORE TAXES. The net income to the business from all transactions. In addition to airline net operating income this includes such items as net profit from the sale of equipment, proceeds from the ownership or sale of investments, revenues of separately operated divisions, revenue from the rental or contractual operation of aircraft, and profit or loss on the exchange of foreign currency.

NET OPERATING INCOME. The total operating revenue from air transportation services less the operating expenses (see definition of Operating Expenses). Net Operating Income is before taxes and interest charges and does not include the nonoperating items in Net Income Before Taxes (see above).

NET PROFIT OR LOSS. Net income after Federal income taxes—the amount available for dividends or investment in the business. This figure is subject to change because of the later adjustment of some accounting transactions and through revision of mail rates and subsidy by regulatory action.

OPERATING EXPENSES. The expenses incurred in the conduct of the business except for such items as debt financing and other non-operating items identified above in Net Income Before Taxes.

OTHER REVENUE. All other revenues, including excess baggage, chartered services, foreign mail, penalties for failure to cancel reservations, service charges on non-revenue transportation of employees and special services such as photography and crop dusting.

PASSENGER REVENUES. Passenger revenues from scheduled operations.

PUBLIC SERVICE REVENUES. Payments by the Federal Government to insure air service to communities in the United States and its territories which could not otherwise afford it; to maintain essential international air routes which are not yet self-supporting; and to develop helicopter service.

U. S. MAIL REVENUE. Service revenue for the transportation of mail. This is the amount paid by the Post Office to purchase air transportation for mail, and is not subsidy.

April 22, 1957

EVER-GROWING PUBLIC USEFULNESS SINCE 1938

All classes of Certified Air Carriers	1938	1956	percent increase
Number of Airlines	23	54	135
Cities Served	286[1]	713[1]	146
Airplanes in Service	345	1,726	400
Seats Available (Daily)	4,800	80,500	1,577
Cruising Speed of Fastest Transport	220	360	64
Number of Passengers Carried	1,536,000	45,943,000	2,891
Number of People Employed	13,300	126,970[2]	855
Total Airline Payrolls	$27,396,000	$629,517,260	2,198
Air Mail Ton Miles	7,449	94,562,000	1,169
Average Fare[3]	5.32c	5.28c	—.8

1 These figures include international cities as well as domestic points and 10 Hawaiian cities; in addition 241 Alaskan points were served in 1956 and 12 in 1938 making a total of 954 cities in 1956 compared to 298 in 1938.
2 As of 6/30/56.
3 Domestic Trunk.

COMMERCE

The scheduled airlines of the United States today fly more than 61 per cent of the entire free world's air passenger traffic.

Under a doctrine of regulated competition established by the Civil Aeronautics Act of 1938 the airlines have built the finest, fastest, most reliable and most competitive—as well as the safest—air transportation system in the world.

Progress in Equipment

The combined fleets of the nation's scheduled airlines by the end of 1956 totaled 1,726 aircraft, representing an investment of more than half a billion dollars.

Speeds have increased. In the time it took the air traveler in 1938 to go from New York to Chicago, today's passenger can fly all the way from New York to Denver.

Capacity is greater. Biggest of today's four-engined airliners can carry five times as many passengers as the twin-engined airliners of 1938. Passenger-wise, all of today's airliners could provide seats for every man, woman and child in a city of 80,000 population. At the same time, they could carry 3,116 tons of mail, express and freight.

Progress in Services Provided

In 1938, half the nation's total population was without any air service at all. Today the nation is spider-webbed with airline routes tying together some 546 U. S. cities, big metropolitan centers and small rural areas. International operations link the U. S. with some 157 cities in 58 different foreign countries. Few localities are without air service of one kind or another.

Competition is increasing. There are almost three times as many certificated scheduled airlines today as there were in 1938. Over-all domestic revenue plane miles flown are up 852 per cent today over the 1938 figure. The average number of daily plane miles flown for all domestic and territorial airlines in 1938 was 196,000. The figure was 1,334,000 in 1956.

The number of airlines serving individual cities has increased greatly since 1938. Today, as many as 18 carriers serve the major terminals like New York and Chicago. In fact, in the past 17 months, competition between carriers was greatly intensified. Competition was added to one-third of the air traffic of the United States with as many as six additional carriers certificated to operate between two cities. In fact, from one to six additional carriers were certificated for 320 city pairs.

The value of the services which the airlines perform is indicated by increased spending on airline travel. In the past ten years, for example, the American public has demonstrated its faith and acceptance of air transportation by buying airline travel at a greater average yearly rate of increase—18 per cent—than any other type of personal purchase.

Safety has helped build this public confidence. In the ten years from 1947, airline accident fatality rates have shown a drop of almost 80 per cent. Moreover, safety record comparisons show that air travel

is, in fact, five times as safe as riding in your own automobile.

What the public is buying today in air transportation is a post-war luxury service at pre-war fare levels. In 1939, the airlines' first full year of operation under the Civil Aeronautics Act, an air passenger paid $44.95 for a ticket from New York to Chicago. (There was only first-class service available.) Flying time was four hours and 35 minutes. Today's air traveler can make the same trip using air coach or air tourist services for only $33.00, a reduction from 1939 fares of more than 25 per cent. The flight takes only two hours and 55 minutes. And today's passenger —whether first-class or coach—rides in an airliner that is far superior to the best of 1939.

Progress Toward Self-Sufficiency

In 1939 mail pay in the form of subsidy, or public service revenue, was a major source of airline income. By comparison, in 1956, public service revenue paid to the airlines represented only 2.3 per cent of their gross income. The domestic trunklines were almost entirely free of subsidy.

And mail pay is no longer a form of subsidy. In fiscal 1939, the domestic scheduled airlines grossed $47,683,759. Public service revenue or subsidy represented 25.9 per cent of this amount.

By comparison, in 1956, public service revenue paid to all the airlines represented only 2.3 per cent of their gross income. The domestic trunklines were almost entirely free of subsidy. Only the local service airlines, certain segments of international routes, the territorial airlines and the new helicopter services still receive public service revenue.

Milestones of 1956

The scheduled airlines carried their 300,000,000th passenger in 1956. Behind this statistic is a far more significant fact than the number itself. It took 24 years for the airlines to carry the first 100,000,000 passengers, four more years to count the second 100,000,000 but only a little over two years to hit the 300,000,000 mark.

Comparing 1956 figures with 1955, the number of passengers carried showed an increase of 10.4 per cent. In 1956, for the second time since the end of the Korean action, the scheduled airlines were solely responsible for a 3.5 per cent increase in the domestic intercity passenger traffic carried by the country's commercial transportation system.

The year showed gains in every type of service which the airlines provide. During 1956, the airlines carried 152,093 ton-miles of air mail, an increase of 10.7 per cent over 1955. Air express shipments increased from 51,285,000 ton-miles in 1955, to 52,278,000 ton-miles in 1956. Air freight jumped from 382,847,000 ton-miles carried in 1955, to 431,256,000 ton-miles carried in 1956.

In the twelve month period, the airlines added 233 airliners to their combined fleets, increasing their capacity to airlift passengers, mail, express and freight by 15.6 per cent.

During the year the industry grossed $1,856,231,000, an increase of 13.6 per cent over the previous year. But, although each individual carrier did more business, operational earnings failed to follow suit, and in some instances losses appeared. Profit margins still lagged substantially behind other public service industries.

At the same time, the industry has committed itself to an additional $2,600,000,000 in orders for more piston-engined aircraft and new jet liners. By year's end, this total number of new aircraft on order totaled 670.

DOMESTIC TRUNKLINES

The domestic trunklines during 1956 carried 81.8 per cent of the total number of passengers who flew on the scheduled airlines. Passenger business for the domestic trunks was up 11.8 per cent and accounted for 90.4 per cent of the total trunkline revenues.

Air coach and air tourist services accounted for 35.9 per cent of the domestic trunkline passenger traffic. First-class service saw a rise of 12.6 per cent.

The trunklines also carried 60.3 per cent of the total air mail ton-miles. Carriage of the mail, by the ton-mile yardstick, was 6.6 per cent over the previous year's figures.

Air express ton-miles showed a gain of 0.2 per cent. Total air freight movements on a ton-mile basis showed a gain of 9.5 per cent.

During the year public service revenues dropped 18.2 per cent from the 1955 figure and amounted to less than .2 of one per cent of their total revenues.

April 22, 1957

INTERNATIONAL

U. S. Flag Carriers during 1956 accounted for 65 per cent of all passengers between the U. S. and foreign countries. During the heavy vacation travel months of June, July and August, the airlines flew more passengers to Europe than went by surface vessel.

The year's totals showed a 10.2 per cent increase in the number of passengers arriving via American international carriers from foreign countries. At the same time, the number of passengers they carried abroad was 10.1 per cent higher than in 1955.

Air coach and air tourist travel to and from the U. S. increased by more than 19 per cent during the year. The low-fare flights accounted for 64 per cent of the international passenger business. First-class traffic increased 9 per cent.

There were also important changes in the international route structure during 1956. The CAB, in permitting two of the U. S. overseas carriers to fly an inter-change operation across the Pacific, in effect, gave the U. S. a second round-the-world air route. One new foreign airline was granted entry into the U. S. and began operations. Another foreign airline began flying a trans-polar service with terminal points in the U. S. Of the total $42,736,000 in public service revenues granted the scheduled airlines in 1956, $8,123,000 went to the international carriers to fly routes in the government's interest.

LOCAL SERVICE

Created as a whole new family of airlines just after the end of World War II, the Local Service Carriers celebrated their tenth full year of operation in 1956. The decade produced many measurements of progress.

By the end of 1956 they had carried 100 times the number of passengers in the past twelve month period as they carried ten years ago. The gain in passenger traffic over 1955 was 21 per cent. Likewise, they have increased their gross revenues eight times since 1947. The increase in 1956, over 1955, was 17.7 per cent with total revenues in last year amounting to $67,380,000.

Although the local service airlines carried only one per cent of the total mail tonnage in 1956, it is significant to point out that without them some 192 U. S. cities would be without any direct air mail service.

The fact that they are making such a contribution to the nation's postal and transportation system accounts for the larger slice which they receive from public service revenue. In 1956 this figure was $22,933,000. The previous year it was $20,714,000. Indicative of their growing importance, however, is the fact that ten years ago they carried 25,000 pasengers, while in 1956 they carried 3,453,000—an increase of 13,712 per cent.

HELICOPTER CARRIERS

In 1956, scheduled helicopter airlines carried a total of 63,000 passengers and 135,000 ton-miles of mail and other cargo. Passenger service showed a gain of 152 per cent over 1955. During the year new and larger helicopters were put into operation. The helicopter passenger, used to riding in a rotorcraft with a capacity for carrying only five persons now can ride in helicopters that can carry 12 passengers. Although a limited number of new helicopters went into service during 1956, the number of seats available on a daily basis increased 98 per cent.

Because it costs more to fly a ton of passengers, mail or cargo by helicopter than it does to airlift the same load in a DC-7 airliner, the helicopter services are getting 5.6 per cent of the public service revenue dollar to help expand their operations. In 1956 this subsidy amounted to $2,544,000. However, public service revenue dropped 6.1 per cent from the 1955 figure.

ALASKAN CARRIERS

During 1956 Alaskan carriers, stimulated by new business in support of the DEW-line radar network, showed 31.4 per cent increase in total revenue. Available ton miles increased 52.4 per cent over 1955. Biggest traffic increase was in charter flights which jumped 151 per cent. The total number of passengers carried showed a 19.3 per cent increase. There was an 11 per cent increase in subsity.

TERRITORIAL CARRIERS

Over-all revenues for the Territorial Carriers in 1956 showed an increase of 4.4 per cent while subsidy declined .7 per cent from the 1955 figure. Total passenger revenue was up 6.3 per cent. Freight revenues increased four per cent from the 1955 level. Charter

AVIATION WEEK

traffic was off 47.1 per cent. Mail showed an increase of .9 per cent.

ALL-CARGO AIRLINES

The all-cargo airlines in 1956 carried 13.3 per cent more freight traffic than they did during the previous twelve-month period. Available ton-miles of the all-cargo carriers increased from 184,521 in 1955 to 284,512. Charter business accounted for the greatest gains in the all-cargo field, 42 per cent of the total revenue ton miles flown. This was an increase of 242 per cent over 1955.

MAIL

The Civil Aeronautics Act of 1938, also said that the scheduled airlines must serve the postal system of the United States.

Since then, public use of the air mail service in the United States, which the scheduled air transport industry provides under contract with the Post Office Department, has increased 1,169 per cent. The airlines, for example, carry today in 50 days the number of air mail letters that they carried in fiscal 1938.

In the beginning, carrying out their responsibility of speeding the mails, the scheduled airlines relied heavily on public service revenues. This was a major source of revenue for the young industry. In 1956, however, total mail pay received by the whole scheduled airline industry amounted to only 3.4 per cent of the industry's gross revenue.

More important is the way the revenues from the air mail stamp are split today as compared with the breakdown in 1938. Then the airlines got 94.5 per cent of the stamp revenue, the Post Office kept 5.5 per cent. In fiscal 1956, the airlines got 17.2 per cent of the stamp revenue, while the Post Office kept 82.8 per cent.

Total revenues generated by the use of air mail (letters, cards and parcel post) for both domestic and international service returned $176,000,000 to the Post Office while the airlines received $61,000,000 for carrying the mail.

In addition, last year, through a special arrangement with the Post Office Department, the airlines on a space available basis carried more than 4,300,000 first-class letters daily between certain cities along

their domestic routes. And this "Three-Cent Air Mail Experiment," as it is called, in 1956, saved billions of hours in delivery time for millions of letter writers. Millions of letters reached their destinations an average of 12 hours sooner than had they traveled by surface means.

Started in 1953, the three-cent mail by air has proven highly successful. The total carriage of three-cent mail on a ton-mile basis was 15,013,000 ton-miles for fiscal 1956, or 19.3 per cent of total ton-miles of domestic mail flown by air. By the end of June 1956, after 33 months of the experiment, the airlines had received a total of $6,745,000 for carrying the three-cent letters between the points affected, less than .2 cents per letter carried. During the same period the service had generated a total of over $100,000,000 in revenue for the Post Office.

The experiment is a success, although the airlines are not certain they are being compensated enough for the service rendered.

At the same time, this does not mean that the regular six-cent air mail doesn't offer a superior service. It does. Regular air mail letters get special handling from the moment they are taken from the mail box. Furthermore, the six-cent air mail stamp is a guarantee that the letter goes by air, even at the expense of turning away passengers if the payload is too heavy. Air mail gets priority over all other types of cargo. The three-cent letter goes by air only when there is space available.

The airlines have also put wings on parcel post packages. Inaugurated on September 1, 1948, use of air parcel post has increased 277 per cent in seven years. The number of pieces flown, both domestic and international, in 1956, was 24,201,198, a gain of 11.9 per cent over the previous year.

NATIONAL DEFENSE

The airlines are constantly ready to augment airlift necessary to the nation's striking military air arm.

The planes, crews and maintenance support which the airlines contribute to the Civil Reserve Air Fleet (CRAF) program save hundreds of millions of dollars in tax monies which otherwise would have to be spent for maintaining emergency airlift on a stand-by basis.

Contributing to the CRAF program—a joint military-airlines operation born of the lessons learned in World War II, the Berlin Airlift and Korea—the scheduled carriers, alone, have 314 four-engine airliners earmarked for CRAF.

The scheduled airlines made available an additional 24 of their biggest and best airliners to CRAF in 1956. The new planes represent a daily increase of more than 1,600,000 ton-mile airlift capacity, bringing the total CRAF capability up to 7,276,160 available ton-mlies per ten-hour day.

The total equipment value of the scheduled airline share in CRAF is estimated at more than $400,000,000. To operate such a fleet on a stand-by basis would cost the government something like $300,000,000 a year.

In addition to their CRAF contribution, the scheduled airlines in 1956 stepped up their activities to provide more and better service to the military organizations using civil air transportation.

The scheduled airlines provided the military agencies with 922,728,874 passenger-miles of official travel in 1956. This is the equivalent of flying 37,000 troops around the world at the equator. For the past seven and a half years the scheduled airlines have effectively served the military departments, in peace and emergency, through the Military Bureau of the Air Transport Association and its field offices.

The scheduled airlines have established over 60 offices at military installations called JAMTO's (Joint Airline Military Traffic Office). These offices, under the jurisdiction of local military committees of the industry, assist in making arrangements for movement of both cargo and personnel.

As an aftermath to the Hungarian Freedom uprisings, a JAMTO was established at reactivated Camp Kilmer. This JAMTO worked around the clock to assist the welfare agencies handling refugees in the domestic transportation to relatives and sponsors.

AIR NAVIGATION AND TRAFFIC CONTROL

Back in 1936, the scheduled airlines devised and put into practice the first system of air traffic control in this country. The operation was embryonic. But it worked and it set the basic pattern for the traffic control system in use today. The true significance, however, is the fact that almost 21 years ago the airlines themselves recognized the problem which today affects everyone who flies.

Today's vast and complicated Air Navigation and Traffic Control System is the direct responsibility of the Federal Government. And the airlines have never held back in contributing to the further development of the system and its upkeep—both in know-how and techniques, and in financial support.

The scheduled airline fleet of over 1,726 planes represents only about 1.6 per cent of the planes using the Federal Airways as they share the system with some 40,000 military planes and another 60,000 private and corporate aircraft.

The nation's air traffic control system is the heart of our national defense air network. Our bombers would not be able to strike, nor our fighters able to defend without it. And these big users of the airways system must have priority for the nation's security. Consequently, the system must be one which can integrate all segments of aviation—the private flyer, the business flyer, the commercial operator and the military—into a common system. It costs many times more than any system which might be required by the airlines alone.

America's system of Air Navigation and Traffic Control is the finest, safest and most extensive network of aerial highways in the world. The only thing wrong is that the system itself has been unable to

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keep pace with the tremendous increases in the number of planes that use it.

The problem is to allocate the required amount of airspace to all users, and then effectively control the traffic using it. The growth of aviation has outstripped our ability to control effectively our present volume of air traffic with the present air traffic control system.

The need is for immediate improvement of the present system to insure safe operation of today's aircraft—an interim system. And beyond this, the need is for a whole new approach to the problem and the development of a completely new system that can handle the expected traffic increases and the bigger and faster planes that are coming.

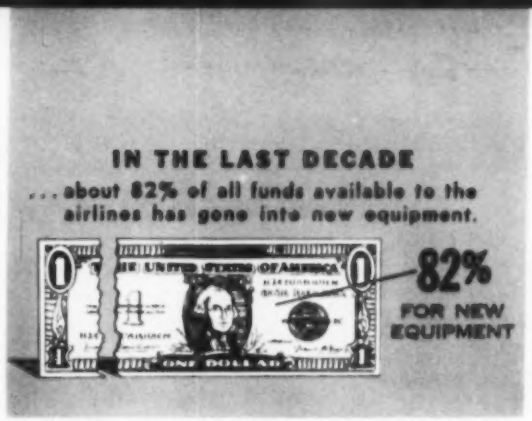
Admittedly, no method of controlling air traffic exists today which will adequately serve tomorrow's planes, in tomorrow's numbers, flying at tomorrow's speeds.

The need for these improvements and a continuing effort to solve the air navigation and traffic control problem was clearly demonstrated on June 21, 1956. On that day, adverse weather conditions taxed the present system to its limits. Over 31 per cent of all airline operations in the eastern half of the United States were cancelled or delayed. And other elements of aviation, including the military, suffered accordingly. It shouldn't have happened. But it did. And it is a striking example for the need of improving the situation.

RESOURCES

Although the scheduled airlines have demonstrated startling increases in providing more and better air service, their ability to earn profits for themselves has lagged far behind their capability to serve the public. Airline profits are way out of balance when they are weighed against the progress the industry has accomplished. Earnings are far below the margins of return of other public service industries. To bring the benefits of jet travel to the public, it is going to be increasingly difficult for the airline industry to pay off its indebtedness unless something is done to improve this earnings trend.

And this becomes even more evident when one considers the estimated net worth of the industry, set at $650,000,000 in 1956, and the $2,600,000,000 already committed for jetliners and other aircraft over the next five years.



Because the technological advances in aeronautical equipment have been so rapid, the airlines have been forced, time and again, into costly re-equipment programs.

For example, if you take trunkline funds from all sources—earnings, sales of additional stock, borrowings, depreciation, property retirements and other amortizations—you come up, for the last ten years, with about $1,760,000,000. Some 82 per cent—$1,443,000,000—of that money was ploughed back into new and better equipment.

Security analysts tell us that a growth industry, such as scheduled air transport, ought to be paying out about 40 per cent of its net income, after taxes, in dividends. The airlines, in the same ten year period, paid out about 32 per cent of net profits after taxes. The comparable figure for all U. S. corporations was 47 per cent of net profits after taxes.

The continuing need for a tremendous outlay of dollars for new equipment is pointed up by the increasing cost of the equipment itself.

In 1946, for example, the largest four-engined airliner then available cost about $625,000. A similar airliner in 1956 was selling for $1,150,000. But, the bigger, faster, four-engined airliners last year cost about $2,000,000 each. The cost per plane of the biggest new jetliners on order will hit $6,250,000, which is fifty times the cost of the DC-3 airliner 20 years ago.

Operating expenses of the scheduled airlines amounted to $1,727,677,000 in 1956, an increase of 15.9 per cent over 1955. In spite of a 15.6 per cent increase in traffic gross profits of the industry were only $133,493,000 in 1956 or a decrease of 7.2 per cent from the previous year.

U. S. Scheduled Airline Industry, *1947-1956 (In Millions)*

	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956
Domestic Trunk Airlines										
Available Ton Miles Flown	1,209.7	1,357.9	1,517.4	1,684.1	1,974.1	2,399.3	2,893.3	3,314.1	3,882.7	4,392.8
Revenue Ton Miles Flown	689.1	706.2	809.0	963.2	1,204.7	1,413.5	1,644.3	1,857.6	2,190.6	2,452.5
Ton Mile Load Factor (%)	56.97	52.01	53.31	57.20	61.02	58.91	56.83	56.05	56.42	55.83
Available Seat Miles Flown	9,152.4	9,980.2	11,117.7	12,385.6	14,672	18,068.1	22,114.4	25,646.5	30,001.3	33,752.6
Revenue Passenger Miles Flown	6,016.3	5,822.4	6,570.7	7,766.0	10,210.8	12,120.8	14,297.6	16,246.3	19,217.2	21,643.1
Passenger Load Factor (%)	65.73	58.34	59.10	62.70	69.59	67.08	64.65	63.31	64.06	64.12
Revenue Plane Miles Flown	311.9	316.3	323.2	327.1	362.5	411.4	467.0	497.2	564.0	622.1
Local Service Airlines										
Available Ton Miles Flown	14.9	31.5	46.4	62.4	81.5	96.2	109.3	112.9	121.9	145.6
Revenue Ton Miles Flown	4.7	9.1	14.3	20.9	31.6	36.1	40.7	47.2	55.0	66.5
Ton Mile Load Factor (%)	31.87	28.92	30.93	33.51	38.79	37.53	37.28	41.77	45.14	45.70
Available Seat Miles Flown	155.5	323.9	477.9	599.2	774.7	905.4	1,013.6	1,069.7	1,161.4	1,385.1
Revenue Passenger Miles Flown	46.4	87.9	134.7	188.8	289.6	339.2	390.9	449.5	523.3	633.2
Passenger Load Factor (%)	29.85	27.14	28.18	31.51	37.39	37.46	38.56	42.02	45.06	45.72
Revenue Plane Miles Flown	10.1	18.0	24.5	33.0	38.0	41.1	45.6	47.7	50.9	59.5
Territorial Airlines										
Available Ton Miles Flown	8.3	9.1	10.1	10.9	13.8	14.2	15.9	15.7	16.1	16.0
Revenue Ton Miles Flown	4.9	5.2	5.3	5.8	6.6	7.0	7.4	7.7	8.8	8.8
Ton Mile Load Factor (%)	59.91	57.12	52.47	52.75	47.86	49.49	46.70	49.17	54.25	54.80
Available Seat Miles Flown	65.9	81.0	91.3	100.1	119.0	124.1	134.6	134.5	134.7	147.2
Revenue Passenger Miles Flown	46.8	52.9	52.6	57.7	65.8	67.9	71.6	72.7	78.1	83.9
Passenger Load Factor (%)	71.10	65.28	57.19	57.66	55.27	54.72	53.37	54.04	57.99	56.99
Revenue Plane Miles Flown	3.1	3.6	4.0	4.3	5.0	5.4	4.9	4.7	4.6	4.6
Helicopter Airlines *(in thousands)*										
Available Ton Miles Flown	14	108	142	189	185	181	350	388	434	574
Revenue Ton Miles Flown	3	28	46	63	71	75	129	152	192	281
Ton Mile Load Factor (%)	18.43	25.93	32.39	33.33	38.38	41.44	36.86	39.18	44.24	48.95
Revenue Passenger Miles Flown	.....	.....	.....	.....	.....	.....	191	716	1,708	3,387
Available Seat Miles Flown	.....	.....	.....	.....	.....	.....	26	183	628	1,583
Passenger Load Factor (%)	.....	.....	.....	.....	.....	.....	13.61	25.56	36.77	46.74
Revenue Planes Miles Flown	37	284	412	668	619	631	1,006	1,071	1,148	1,323
International and Overseas Airlines										
Available Ton Miles Flown	425.8	480.8	540.3	554.2	608.4	693.7	760.5	856.1	982.6	1,146.9
Revenue Ton Miles Flown	243.7	273.5	300.4	325.4	377.8	426.3	466.8	527.1	622.4	728.1
Ton Mile Load Factor (%)	57.24	56.89	55.60	58.17	62.09	61.45	61.38	61.57	63.34	63.48
Available Seat Miles Flown	2,924.3	3,292.3	3,624.7	3,695.5	4,361.4	4,848.8	5,462.2	6,284.9	7,012.1	8,073.2
Revenue Passenger Miles Flown	1,810.0	1,888.9	2,054.0	2,206.4	2,599.0	3,019.8	3,381.1	3,743.3	4,409.6	5,116.4
Passenger Load Factor (%)	61.90	57.37	56.67	59.7[illegible]	59.59	62.28	61.90	59.56	62.89	63.38
Revenue Plane Miles Flown	86.5	98.1	104.5	93.8	97.4	103.4	109.6	116.1	130.7	146.0

AVAILABLE SERVICE AND UTILIZATION *(continued)*

U. S. Scheduled Airline Industry, *1947-1956 (In Millions)*

	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956
Alaskan Airlines										
Available Ton Miles Flown		20.1	20.3	19.7	15.8	26.7	34.1	34.5	46.0	66.9
Revenue Ton Miles Flown		12.8	11.1	10.1	8.5	14.4	19.5	19.4	29.4	44.7
Ton Mile Load Factor (%)	Not	63.64	54.76	50.93	54.16	53.89	57.23	56.37	63.83	66.85
Available Seat Miles Flown	Available	42.6	38.9	54.0	82.4	168.8	209.2	206.3	233.9	284.1
Revenue Passenger Miles Flown		19.6	15.4	22.4	36.5	71.2	92.4	86.9	110.4	136.9
Passenger Load Factor (%)		46.10	39.64	41.60	44.26	42.18	44.15	42.15	47.20	48.20
Revenue Plane Miles Flown		4.6	3.9	5.4	6.9	9.3	10.4	9.6	10.5	11.3
All Cargo Airlines'										
Available Ton Miles Flown	.....	.....	16.5	80.2	126.2	118.6	121.8	108.8	184.5	284.5
Revenue Ton Miles Flown	.....	.....	11.6	59.5	103.6	97.0	99.3	88.6	136.0	216.8
Ton Mile Load Factor (%)	.....	.....	70.52	74.20	82.10	81.82	81.51	81.48	73.70	76.19
Available Seat Miles Flown	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Revenue Passenger Miles Flown	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Passenger Load Factor (%)	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Revenue Plane Miles Flown	.....	.....	2.9	13.3	19.9	18.5	19.1	12.6	20.3	25.5
Total Scheduled Airline Industry										
Available Ton Miles Flown	1,658.7	1,899.5	2,151.1	2,411.6	2,819.9	3,348.9	3,935.3	4,442.5	5,234.2	6,053.3
Revenue Ton Miles Flown	942.4	1,006.8	1,151.8	1,384.9	1,732.8	1,994.3	2,278.2	2,547.8	3,042.4	3,517.7
Ton Mile Load Factor (%)	56.82	53.29	53.54	57.43	61.45	59.55	57.89	57.35	58.13	58.11
Available Seat Miles Flown	12,298.1	13,720.0	15,350.5	16,834.4	20,009.5	24,115.2	28,934.6	33,342.6	38,545.1	43,645.5
Revenue Passenger Miles Flown	7,919.5	7,871.7	8,827.4	10,241.3	13,201.6	15,618.9	18,233.8	20,598.9	24,339.2	27,615.1
Passenger Load Factor (%)	64.40	57.37	57.51	60.84	65.98	67.77	63.02	61.78	63.14	63.27
Revenue Plane Miles Flown	411.6	440.9	463.1	477.6	530.3	589.7	657.6	689.0	782.1	870.4

' Riddle and AAXICO data not included in 1956.

REVENUE TON-MILE TRAFFIC CARRIED

by U. S. Scheduled Airline Industry, *1947-1956 (in Thousands of Revenue Ton-Miles)*

	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956
Domestic Trunk Airlines										
Passenger	579,859	558,680	632,014	747,558	982,642	1,167,556	1,377,728	1,568,413	1,856,196	2,091,517
Freight	35,214	70,438	94,190	112,861	100,581	117,128	131,778	144,276	174,023	190,597
U. S. Mail	32,879	37,510	40,874	46,315	62,932	68,296	71,725	80,201	86,034	91,686
Express	28,553	29,769	27,329	36,538	40,260	40,375	42,514	40,122	49,608	49,711
Charter Flights	5,774	3,158	7,483	8,203	8,576	8,593	6,874	8,317	5,730	5,884
All Other	6,875	6,657	7,102	11,782	9,680	11,512	13,706	16,288	19,049	23,060
Total	689,134	706,212	808,992	963,257	1,204,671	1,413,460	1,644,325	1,857,617	2,190,640	2,452,455

by U. S. Scheduled Airlines, *1947-1956 (in thousands of dollars)*

	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956
Local Service Airlines										
Passenger	4,316	8,184	12,908	18,242	27,904	32,373	36,767	42,396	49,442	59,862
Freight	62	265	436	696	920	1,116	1,179	1,158	1,355	1,625
U. S. Mail	165	334	428	566	787	912	1,000	1,226	1,257	1,572
Express	118	190	320	623	908	894	954	1,043	1,403	1,688
Charter Flights	59	90	194	653	961	653	649	1,108	1,338	1,487
All Other	18	39	60	118	132	168	198	224	245	312
Total	4,738	9,102	14,346	20,898	31,612	36,116	40,747	47,155	55,040	66,546
Territorial Airlines										
Passenger	3,839	4,309	4,309	4,680	5,234	5,354	5,806	5,929	6,599	6,991
Freight	636	581	618	529	855	1,258	1,503	1,657	1,646	1,477
U. S. Mail	43	53	70	65	59	50	57	58	58	65
Express	116	134	124	119	100	55	.....	.....	.....	.....
Charter Flights	184	39	123	304	283	272	27	45	436	235
All Other	68	68	66	56	50	49	46	34	20	19
Total	4,886	5,184	5,310	5,753	6,581	7,038	7,439	7,723	8,759	8,787
Helicopter Airlines										
Passenger	.....	.....	.....	.....	.....	.....	2	17	57	145
Freight	.....	.....	.....	.....	.....	.....	2	5	5	7
U. S. Mail	3	28	46	63	71	75	123	115	96	92
Express	.....	.....	.....	.....	.....	.....	.....	13	31	36
All Other	.....	.....	.....	.....	.....	.....	2	2	3	1
Total	3	28	46	63	71	75	129	152	192	281
International and Overseas Airlines										
Passenger	184,303	194,399	211,734	228,114	266,989	310,716	345,383	379,787	442,808	511,673
Freight	2,110	4,012	6,714	16,050	71,004	72,346	74,427	81,886	89,598	109,227
U. S. Mail	12,756	17,203	19,772	21,188	21,875	22,068	24,466	35,323	52,409	55,155
Express	30,786	41,581	49,444	44,513	289	281	219	217	243	.....
Charter Flights	5,275	7,990	3,233	5,730	6,724	7,846	7,700	13,790	19,701	32,370
All Other	8,483	8,314	9,515	9,8[illegible]5	10,903	13,051	14,583	16,136	17,647	19,690
Total	243,713	273,499	300,412	325,420	377,784	426,308	466,778	527,139	622,486	728,115
Alaskan Airlines										
Passenger	.....	1,962	1,543	2,245	3,743	7,490	9,838	9,139	11,752	14,617
Freight	.....	1,027	618	882	1,763	4,252	5,908	5,998	7,300	7,955
U. S. Mail	.....	281	479	741	970	1,591	1,987	2,058	2,379	2,381
Charter Flights	.....	9,509	8,449	6,095	2,016	955	1,640	2,086	7,773	19,532
All Other	.....	40	27	90	51	99	114	114	149	243
Total	.....	12,819	11,116	10,053	8,543	14,387	19,487	19,395	29,353	44,728

REVENUE TON-MILE TRAFFIC CARRIED (continued)

by U. S. Scheduled Airline Industry, *1947-1956 (in Thousands of Revenue Ton-Miles)*

	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956
All Cargo Airlines'										
Passenger	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Freight	.....	.....	10,542	58,420	78,578	92,367	88,812	76,653	108,920	123,368
U. S. Mail	.....	.....	.....	.....	.....	.....	.....	.....	322	1,147
Express	.....	.....	.....	.....	.....	.....	.....	.....	.....	843
Charter Flights	.....	.....	1,124	1,125	25,038	4,670	10,517	11,988	26,758	91,415
Excess Baggage	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Total	.....	.....	11,666	59,545	103,616	97,037	99,329	88,641	136,000	216,773
Total Scheduled Airlines Industry										
Passenger	772,317	767,534	862,508	1,000,839	1,286,512	1,523,489	1,775,524	2,005,681	2,366,854	2,684,805
Freight	38,022	76,323	113,118	189,438	253,701	288,467	303,609	311,633	382,847	434,256
U. S. Mail	45,846	55,409	61,669	68,938	86,694	92,992	99,358	118,981	142,555	152,098
Express	59,553	71,674	77,217	81,793	41,557	41,605	43,687	41,395	51,285	52,278
Charter Flights	11,292	20,786	20,606	22,110	43,598	22,989	27,407	37,334	61,736	150,923
All Other	15,444	15,118	16,770	21,871	20,816	24,879	28,649	32,798	37,113	43,325
Total	942,474	1,006,844	1,151,888	1,384,989	1,732,878	1,994,421	2,278,234	2,547,822	3,042,390	3,517,685

' Riddle and AAXICO data not included in 1956.

OPERATING REVENUES

U. S. Scheduled Airlines, *1947-1956' (in thousands of dollars)*

	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956'
Domestic Trunk Airlines										
Passenger	$ 303,194	334,736	378,113	430,098	570,288	671,257	775,782	872,834	1,021,853	1,142,124
Freight	$ 8,358	13,825	18,323	21,698	21,030	25,529	29,341	33,009	39,605	42,166
U. S. Mail	$ 23,326	47,838	45,031	46,311	37,040	35,910	37,083	37,315	30,130	34,202
Express	$ 10,530	9,964	8,957	12,569	14,706	15,853	16,829	15,107	19,405	18,057
Other	$ 7,082	6,990	9,359	13,433	15,457	19,466	19,758	19,953	22,355	26,207
Total	$ 352,490	413,353	459,783	524,109	658,521	768,015	878,793	978,218	1,133,348	1,262,758
Local Service Airlines										
Passenger	$ 2,280	4,667	7,362	10,303	16,259	19,766	23,306	27,673	32,840	40,139
Freight	$ 17	76	138	212	309	405	462	502	556	746
U. S. Mail	$ 5,920	10,911	13,533	16,581	18,850	21,177	24,356	24,893	21,896	24,050
Express	$ 43	72	114	230	357	417	463	496	665	774
Other	$ 151	195	271	544	966	614	771	1,151	1,279	1,671
Total	$ 8,411	15,921	21,418	27,870	36,741	42,379	49,358	54,715	57,236	67,380

' Preliminary data.

U. S. Scheduled Airlines, *1947-1956 (in thousands of dollars)*

	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956[1]
Territorial Airlines										
Passenger $	3,102	3,888	3,799	4,105	4,639	4,433	4,771	5,270	5,685	6,042
Freight $	321	302	333	288	393	562	692	732	752	782
U. S. Mail $	162	189	247	285	643	768	1,128	640	338	341
Express $	108	134	145	125	119	63	.....	.....	.....	.....
Other $	208	137	254	410	418	420	135	148	338	265
Total $	3,901	4,650	4,778	5,213	6,212	6,246	6,726	6,790	7,114	7,430
Helicopter Airlines										
Passenger $	.....	.....	.....	.....	.....	.....	10	63	205	440
Freight $	.....	.....	.....	.....	.....	.....	4	16	21	29
U. S. Mail $	37	372	522	791	887	1,033	2,547	2,878	2,948	2,776
Express $	.....	.....	.....	.....	.....	.....	.....	35	95	114
Other $	.....	.....	.....	7	5	13	44	78	82	63
Total $	37	372	522	798	892	1,046	2,605	3,070	3,351	3,422
International and Overseas Airlines										
Passenger $	140,652	151,338	158,480	160,673	184,592	212,458	232,539	254,234	294,824	347,613
Freight $	689	1,370	2,105	5,881	25,116	26,730	27,257	29,614	31,854	36,774
U. S. Mail $	32,300	57,332	75,197	55,689	53,213	51,553	53,746	49,192	27,223	35,306
Express $	16,837	19,438	20,023	15,783	94	87	74	70	77	.....
Other $	18,532	19,756	18,350	22,105	24,784	24,110	23,670	25,739	30,324	38,064
Total $	209,010	249,234	274,155	260,131	287,799	314,918	337,286	358,849	384,302	452,757
Alaskan Airlines										
Passenger $	.....	2,492	2,188	2,758	4,042	5,857	6,815	6,479	8,162	10,188
Freight $	.....	529	547	639	928	1,474	1,851	1,837	2,464	2,761
U. S. Mail $	.....	1,530	2,122	2,939	3,742	7,524	9,060	9,226	7,954	8,719
Other $	.....	3,798	3,639	3,102	3,430	1,106	1,574	1,662	3,747	7,671
Total $	.....	8,349	8,496	9,438	12,142	15,961	19,300	19,204	22,324	29,339
All Cargo Airlines[2]										
Passenger $	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Freight $	.....	.....	1,810	8,850	12,017	14,498	14,825	13,958	18,634	23,586
U. S. Mail $	.....	.....	.....	.....	.....	.....	.....	.....	57	497
Other $	.....	.....	300	3,511	5,348	2,549	4,391	3,001	8,336	14,008
Total $	.....	.....	2,110	12,361	17,365	17,047	19,216	16,959	27,027	38,090

[1] Preliminary data.
[2] Seaboard and Western data not included in 1956.

AVIATION WEEK

OPERATING REVENUES (continued)

U. S. Scheduled Airlines, *1947-1956 (in thousands of dollars)*

	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956[1]
Total Scheduled Airline Industry										
Passenger	$ 449,228	497,121	549,942	607,937	779,820	913,771	1,043,223	1,166,553	1,363,569	1,541,545
Freight	$ 9,385	16,102	23,256	37,568	59,793	69,198	74,432	79,668	93,886	106,843
U. S. Mail	$ 61,745	118,172	136,652	122,596	114,375	117,945	127,920	124,144	91,869	195,891
Express	$ 27,518	29,608	29,239	28,707	15,276	16,420	17,366	15,708	20,246	18,945
Other	$ 25,973	30,876	32,173	43,112	50,408	48,278	50,343	51,732	65,137	87,951
Total	$ 573,849	691,879	551,262	839,920	1,019,672	1,165,612	1,313,284	1,437,805	1,634,707	1,861,175

[1] Preliminary data

DISTRIBUTION OF AIRCRAFT OPERATING EXPENSES

U. S. Scheduled Airlines, *1947-1956 (in thousands of dollars)*

	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956[1]
Domestic Trunk Airlines										
Flying Operations	$ 85,933	104,164	119,961	132,060	160,469	193,384	234,928	260,234	302,526	340,720
% of Total Expenses	23.0	25.3	27.6	28.6	29.0	28.7	29.7	29.6	30.0	29.3
Direct Maint.—Flight Equip.	$ 41,029	46,093	50,270	53,747	66,571	86,452	94,816	103,104	127,418	156,549
% of Total Expenses	11.0	11.2	11.6	11.6	12.0	12.8	12.0	11.7	12.6	13.5
Depreciation—Flight Equip.	$ 36,241	39,534	39,448	39,430	41,273	57,735	79,305	94,344	90,226	93,547
% of Total Expenses	9.7	9.6	9.1	8.5	7.5	8.6	10.0	10.7	8.9	8.0
Total Aircraft Oper. Expenses	$163,203	189,791	209,679	225,237	268,313	337,571	409,049	457,682	520,170	590,816
Local Service Airlines										
Flying Operations	$ 2,190	4,433	6,336	8,330	10,944	13,394	15,748	17,246	18,070	21,556
% of Total Expenses	24.3	28.5	29.0	30.8	30.5	30.8	30.9	32.5	31.8	31.6
Direct. Maint.—Flight Equip.	$ 1,332	2,289	3,198	3,433	4,284	5,451	6,479	5,950	6,709	8,235
% of Total Expenses	14.8	14.7	14.6	12.7	11.9	12.5	12.7	11.2	11.8	12.1
Depreciation—Flight Equip.	$ 908	1,375	1,938	1,492	1,613	2,098	2,443	1,893	1,818	2,148
% of Total Expenses	10.1	8.8	8.4	5.5	4.5	4.8	4.8	3.6	3.2	3.2
Total Aircraft Oper. Expenses	$ 4,430	8,097	11,472	13,255	16,841	20,943	24,670	25,089	26,597	31,939
Territorial Airlines										
Flying Operations	$ 704	946	1,091	1,221	1,468	1,623	1,875	1,908	1,942	2,032
% of Total Expenses	18.8	21.3	22.6	23.1	24.2	27.2	27.7	27.0	26.5	27.8
Direct Maint.—Flight Equip.	$ 537	603	551	543	644	580	625	713	715	716
% of Total Expenses	14.4	13.6	11.4	10.3	10.6	9.7	9.2	10.1	9.8	9.8
Depreciation—Flight Equip.	$ 259	330	331	359	253	143	392	482	488	320
% of Total Expenses	6.9	7.4	6.9	6.8	4.2	2.4	5.8	6.8	6.7	4.4
Total Aircraft Oper. Expenses	$ 1,500	1,879	1,973	2,123	2,365	2,346	2,892	3,103	3,145	3,068

[1] Preliminary data

U. S. Scheduled Airlines, *1947-1956 (in thousands of dollars)*

	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956[1]
Helicopter Airlines										
Flying Operations	$ 13	94	151	205	135	264	540	583	613	707
% of Total Expenses	25.0	27.2	29.6	28.0	18.7	25.1	22.8	22.1	20.7	19.1
Direct Maint.—Flight Equip.	$ 5	50	83	116	182	213	418	533	566	626
% of Total Expenses	9.6	14.5	16.3	16.0	25.2	20.3	20.3	20.2	19.2	16.9
Depreciation—Flight Equip.	$ 14	81	105	123	76	128	456	391	405	549
% of Total Expenses	26.9	23.4	20.6	16.8	10.5	12.2	19.3	14.8	13.7	14.8
Total Aircraft Oper. Expenses	$ 32	225	339	444	393	605	1,477	1,507	1,584	1,882
International and Overseas Airlines										
Flying Operations	$ 53,189	67,163	72,347	70,980	75,031	87,368	91,489	98,755	108,553	125,546
% of Total Expenses	25.4	28.5	28.6	28.6	27.8	28.7	28.8	29.7	29.7	29.9
Direct Maint.—Flight Equip.	$ 21,997	24,241	26,311	26,158	29,856	33,043	32,808	30,811	34,632	44,696
% of Total Expenses	10.5	10.3	10.4	10.5	11.1	10.9	10.3	9.3	9.5	10.7
Depreciation—Flight Equip.	$ 18,580	19,589	23,676	25,638	24,263	26,480	26,723	27,799	27,547	30,942
% of Total Expenses	8.9	8.3	9.4	10.3	9.0	8.7	8.4	8.4	7.5	7.4
Total Aircraft Oper. Expenses	$ 93,766	110,993	122,334	122,776	129,150	146,891	151,020	157,365	170,732	201,184
Alaskan Airlines										
Flying Operations	$	3,138	3,440	3,020	4,160	4,634	5,479	5,224	7,232	9,899
% of Total Expenses	.....	38.9	33.8	31.1	31.6	28.4	30.0	28.9	33.0	36.4
Direct Maint.—Flight Equip.	$	923	1,342	1,591	2,257	2,744	2,673	2,580	3,083	3,610
% of Total Expenses	.....	11.4	13.2	16.4	17.2	16.8	14.7	14.3	15.0	13.3
Depreciation—Flight Equip.	$	810	987	880	718	741	863	1,087	899	1,008
% of Total Expenses	.....	10.0	9.7	9.1	5.5	4.5	4.7	6.0	4.1	3.7
Total Aircraft Oper. Expenses	$	4,871	5,769	5,491	7,135	8,119	9,015	8,891	11,214	14,517
All Cargo Airlines[2]										
Flying Operations	$	.....	966	4,633	6,361	6,752	8,062	7,834	10,632	15,997
% of Total Expenses	.....	.....	42.3	42.9	44.4	42.4	42.2	39.6	40.4	40.2
Direct Maint.—Flight Equip.	$	.....	270	1,332	1,823	2,808	3,121	2,668	3,782	5,972
% of Total Expenses	.....	.....	11.8	12.3	12.7	17.6	16.3	13.5	14.4	15.0
Depreciation—Flight Equip.	$	.....	54	246	356	495	836	1,930	1,834	2,793
% of Total Expenses	.....	.....	2.4	2.3	2.5	3.1	4.4	9.8	7.0	7.0
Total Aircraft Oper. Expenses	$	.....	1,290	6,211	8,540	10,055	12,019	12,432	16,248	24,762
Total Scheduled Airline Industry										
Flying Operations	$142,029	179,938	204,292	220,449	258,568	307,419	358,121	391,784	449,568	516,457
% of Total Expenses	23.9	26.7	28.1	28.9	29.0	29.0	29.7	29.9	30.2	29.9
Direct Maint.—Flight Equip.	$ 64,900	74,199	82,025	86,920	105,617	131,291	141,003	146,359	176,905	220,404
% of Total Expenses	10.9	11.0	11.3	11.4	11.8	12.4	11.7	11.2	11.9	12.8
Depreciation—Flight Equip.	$ 56,002	61,719	66,539	68,168	68,552	87,820	111,018	127,926	123,217	131,307
% of Total Expenses	9.4	9.1	9.1	8.9	7.7	8.3	9.2	9.7	8.3	7.6
Total Aircraft Oper. Expenses	$262,931	315,856	352,856	375,537	432,737	526,530	610,142	666,069	749,690	868,168

[1] Preliminary data.
[2] Seaboard and Western data not included in 1956.

AVIATION WEEK

DISTRIBUTION OF GROUND AND INDIRECT EXPENSES

U. S. Scheduled Airlines, *1947-1956 (in thousands of dollars)*

	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956[1]
Domestic Trunk Airlines										
Ground Operations	$ 59,464	64,915	66,623	68,541	79,265	94,606	107,044	119,207	133,231	152,884
Ground and Indirect Maintenance	$ 32,812	33,515	33,404	33,653	41,110	50,856	56,940	61,331	68,736	82,760
Passenger Service	$ 28,669	29,151	27,778	30,870	42,563	47,045	53,115	58,235	72,978	83,938
Traffic and Sales	$ 42,644	42,668	45,661	48,079	58,024	70,253	81,472	89,788	103,882	124,507
Advertising and Publicity	$ 9,486	12,343	13,533	14,566	16,211	18,880	22,027	24,861	30,809	34,807
General and Administrative	$ 31,052	31,217	30,894	33,651	40,816	46,874	52,259	57,744	68,827	79,646
Depreciation—Ground Equipment	$ 6,060	7,678	7,585	6,941	6,279	6,807	8,515	10,411	11,430	12,737
Total—Ground and Indirect Expenses	$210,187	221,487	225,478	236,301	284,268	335,321	381,372	421,077	489,893	571,279
Local Service Airlines										
Ground Operations	$ 1,650	2,682	3,743	4,969	6,229	7,254	8,406	8,753	9,511	11,168
Ground and Indirect Maintenance	$ 740	1,114	1,339	1,823	2,496	3,150	3,596	3,666	3,756	4,328
Passenger Service	$ 261	540	825	1,090	1,671	1,944	2,218	2,389	2,684	3,383
Traffic and Sales	$ 660	1,053	1,771	2,434	3,943	4,868	6,099	6,895	7,618	9,465
Advertising and Publicity	$ 251	386	634	807	1,072	1,172	1,340	1,449	1,656	1,918
General and Administrative	$ 902	1,436	1,792	2,484	3,301	3,682	4,028	4,330	4,463	5,358
Depreciation—Ground Equipment	$ 123	270	295	344	440	484	546	535	554	629
Total—Ground and Indirect Expenses	$ 4,587	7,481	10,399	13,951	19,152	22,554	26,233	28,017	30,242	36,249
Territorial Airlines										
Ground Operations	$ 767	904	922	906	1,040	1,001	1,212	1,269	1,258	1,317
Ground and Indirect Maintenance	$ 342	357	349	399	433	384	482	532	562	541
Passenger Service	$ 97	140	165	190	223	213	210	198	245	252
Traffic and Sales	$ 385	441	528	681	858	881	768	769	842	958
Advertising and Publicity	$ 50	42	100	151	172	167	143	140	204	226
General and Administrative	$ 502	567	682	743	887	899	953	955	963	847
Depreciation—Ground Equipment	$ 96	103	113	93	89	81	97	114	116	97
Total—Ground and Indirect Expenses	$ 2,239	2,554	2,859	3,163	3,702	3,626	3,865	3,977	4,190	4,238
Helicopter Airlines										
Ground Operations	$ 3	33	50	98	108	138	283	334	425	543
Ground and Indirect Maintenance	$ 6	39	50	66	89	124	217	275	305	360
Passenger Service	$						11	15	22	22
Traffic and Sales	$						26	75	141	269
Advertising and Publicity	$	2	2	2	1	3	17	32	40	43
General and Administrative	$ 9	43	63	112	119	164	306	365	393	499
Depreciation—Ground Equipment	$ 2	4	6	10	11	16	30	35	45	84
Total—Ground and Indirect Expenses	$ 20	121	171	288	328	445	890	1,131	1,371	1,820
International and Overseas Airlines										
Ground Operations	$ 30,460	31,005	33,168	31,618	34,916	39,726	42,189	43,397	47,050	51,468
Ground and Indirect Maintenance	$ 17,805	20,219	20,934	17,282	20,014	21,188	22,219	22,302	24,236	27,354
Passenger Service	$ 13,084	14,034	14,617	14,589	17,511	19,554	20,027	22,372	26,716	31,050
Traffic and Sales	$ 21,996	25,350	25,560	25,886	29,821	34,945	37,727	40,573	45,872	53,163
Advertising and Publicity	$ 6,745	7,861	10,171	10,628	11,374	12,541	13,692	14,273	16,095	17,679
General and Administrative	$ 22,722	22,887	22,600	22,170	23,903	26,754	27,931	28,970	31,377	33,824
Depreciation—Ground Equipment	$ 2,716	2,938	3,479	3,374	3,041	2,668	3,102	3,434	3,526	3,696
Total—Ground and Indirect Expenses	$115,528	124,294	130,529	125,547	140,580	157,376	166,887	175,321	194,872	218,234

[1] Preliminary data

April 22, 1957

DISTRIBUTION OF GROUND AND INDIRECT EXPENSES *(continued)*

U. S. Scheduled Airlines, *1947-1956 (in thousands of dollars)*

	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956[1]
Alaskan Airlines										
Ground Operations	$	845	988	966	1,411	2,182	2,449	2,612	4,224	5,389
Ground and Indirect Maintenance	$	525	1,001	774	1,429	1,923	1,919	1,997	2,010	2,256
Passenger Service	$	268	370	358	501	694	797	696	771	962
Traffic & Sales	$	435	598	499	699	1,170	1,364	1,384	1,321	1,514
Advertising and Publicity	$	102	116	135	175	209	297	265	275	321
General and Administrative	$	903	1,180	1,332	1,591	1,767	2,100	1,952	1,582	1,872
Depreciation—Ground Equip.	$	121	156	148	204	264	302	308	310	359
Total—Ground & Indirect Expenses	$	3,199	4,409	4,212	6,010	8,209	9,228	9,214	10,493	12,673
All Cargo Airlines[1]										
Ground Operations	$		206	1,033	982	2,383	2,844	2,812	3,895	6,228
Ground and Indirect Maintenance	$		97	437	747	875	800	1,138	1,503	2,335
Passenger Service	$				1		23	209	269	630
Traffc and Sales	$		445	1,939	2,886	1,004	1,233	945	1,788	2,565
Advertising and Publicity	$		8	40	107	309	249	70	288	428
General and Administrative	$		215	1,047	1,007	1,182	1,760	1,969	2,103	2,490
Depreciation—Ground Equip.	$		20	83	71	109	163	198	239	340
Total—Ground & Indirect Expenses	$		991	4,579	5,801	5,862	7,072	7,341	10,085	15,016
Total Scheduled Airline Industry										
Ground Operations	$ 92,344	100,384	105,700	108,131	123,951	147,290	164,427	178,384	199,594	228,997
Ground and Indirect Maintenance	$ 51,705	55,769	57,174	54,434	66,318	78,500	86,173	91,241	101,108	119,934
Passenger Service	$ 42,111	44,133	43,755	47,097	62,470	69,450	76,401	84,114	103,685	120,237
Traffic and Sales	$ 65,685	69,947	74,563	79,518	96,231	113,121	128,689	139,929	161,464	192,441
Advertising and Publicity	$ 16,532	20,736	24,564	26,329	29,112	33,281	37,765	41,090	49,367	55,422
General and Administrative	$ 55,187	57,053	57,426	61,539	71,624	81,322	89,337	96,284	109,708	124,536
Depreciation—Ground Equip.	$ 8,997	11,114	11,654	10,993	10,135	10,429	12,755	15,035	16,220	17,942
Total—Ground & Indirect Expenses	$332,561	359,136	374,836	388,041	459,841	533,393	595,547	646,077	741,146	859,509

[1] Seaboard and Western data not included in 1956.

SUMMARY OF PROFIT OR LOSS

U. S. Scheduled Airlines, *1947-1956 (in thousands of dollars)*

	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956[2]
Domestic Trunk Airlines										
Total Operating Revenues	$ 352,490	413,353	459,783	524,109	658,521	768,015	878,793	978,218	1,133,348	1,262,758
Total Operating Expenses	$ 373,390	411,278	435,157	461,538	552,581	672,892	790,421	878,759	1,010,063	1,162,095
Net Operating Income	$ (20,900)	2,075	24,626	62,571	105,940	95,123	88,372	99,458	123,285	100,663
Net Income Before Taxes[1]	$ (26,258)	(1,413)	20,663	59,305	103,355	102,814	96,008	102,161	133,075	114,832
Income Taxes	$ (6,016)	3,583	7,285	28,426	59,858	49,280	47,624	50,671	70,062	57,408
Net Profit or Loss	$ (20,242)	(4,996)	13,378	30,879	43,497	53,534	48,384	51,490	63,013	57,424

[1] Net income before taxes is adjusted for nonoperating items.
( ) Denotes red figures.
[2] Preliminary data.

AVIATION WEEK

SUMMARY OF PROFIT OR LOSS *(continued)*

U. S. Scheduled Airlines, *1947-1956 (in thousands of dollars)*

	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956[2]
Local Service Airlines										
Total Operating Revenues	$ 8,411	15,921	21,418	27,683	36,741	42,379	49,358	54,473	57,236	67,380
Total Operating Expenses	$ 9,017	15,578	21,871	27,206	35,993	43,497	50,903	53,105	56,839	68,188
Net Operating Income	$ (606)	343	(453)	477	802	(1,118)	(1,545)	1,368	397	(808)
Net Income Before Income Taxes[1]	$ (1,182)	(486)	(1,283)	(176)	601	(345)	(2,080)	1,212	637	(962)
Income Taxes	$ (77)	94	168	399	399	141	(47)	254	481	39
Net Profit or Loss	$ (1,105)	(580)	(1,451)	(575)	202	(486)	(2,033)	958	157	(923)
Territorial Airlines										
Total Operating Revenues	$ 3,901	4,650	4,778	5,213	6,212	6,246	6,726	6,788	7,114	7,430
Total Operating Expenses	$ 3,739	4,433	4,832	5,286	6,067	5,972	6,757	7,080	7,335	7,306
Net Operating Income	$ 162	217	(54)	(73)	145	274	(31)	(292)	(221)	124
Net Income Before Income Taxes[1]	$ 124	167	(132)	(135)	125	254	(10)	(454)	(117)	14
Income Taxes	$ 35	65	57	3	77	88	(51)	(27)	8	....
Net Profit of Loss	$ 89	102	(189)	(138)	48	166	41	(427)	(125)	14
Helicopter Airlines										
Total Operating Revenues	$ 37	372	522	798	892	1,046	2,605	3,069	3,351	3,422
Total Operating Expenses	$ 52	346	510	732	721	1,050	2,367	2,638	2,955	3,702
Net Operating Income	$ (15)	26	12	66	171	(4)	238	431	396	(280)
Net Income Before Income Taxes[1]	$ (22)	(4)	(16)	36	138	(50)	168	353	543	(345)
Income Taxes	$	....	....	8	42	30	68	163	201	(1)
Net Profit or Loss	$ (22)	(4)	(16)	28	96	(80)	100	190	342	(344)
International & Overseas Airlines										
Total Operating Revenues	$ 209,010	249,234	274,155	260,131	287,799	314,918	337,286	358,856	384,302	452,757
Total Operating Expenses	$ 209,294	235,287	252,863	248,323	269,730	304,267	317,907	322,686	365,604	419,418
Net Operating Income	$ (284)	13,947	21,292	11,808	18,069	10,651	19,379	26,170	18,698	33,339
Net Income Before Income Taxes[1]	$ (4,473)	8,780	8,816	13,631	18,801	14,380	23,393	29,723	23,581	38,158
Income Taxes	$ 651	2,415	1,362	3,623	7,063	6,651	10,865	13,047	10,355	17,847
Net Profit or Loss	$ (5,124)	6,365	7,454	10,008	11,738	7,729	12,528	16,676	13,226	20,311
Alaskan Airlines										
Total operating Revenues	$	8,349	8,496	9,438	12,142	15,961	19,300	19,206	22,329	29,339
Total Operating Expenses	$	8,070	10,178	9,703	13,145	16,328	18,243	18,105	21,707	27,190
Net Operating Income	$	279	(1,682)	(265)	(1,003)	(367)	1,057	1,099	617	2,149
Net Income Before Income Taxes[1]	$	171	(1,817)	(396)	(1,196)	(78)	873	1,126	828	1,957
Income Taxes	$	26	15	37	24	373	113	232	259	896
Net Profit or Loss	$	145	(1,832)	(433)	(1,220)	(451)	760	894	569	1,061

[1] Net income before taxes is adjusted for nonoperating items.

( ) Denotes red figures.

[2] Preliminary data.

April 22, 1957

SUMMARY OF PROFIT OR LOSS *(continued)*

U. S. Scheduled Airlines, *1947-1956 (in thousands of dollars)*

	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956[2]
All Cargo Airlines[1]										
Total Operating Revenues	$		2,110	12,361	17,365	17,047	19,216	16,959	27,027	38,090
Total Operating Expenses	$		2,281	10,790	14,341	15,917	19,091	19,773	26,333	39,778
Net Operating Income	$		(171)	1,571	3,024	1,130	125	(2,814)	694	(1,688)
Net Income Before Income Taxes[1]	$		(153)	1,779	3,735	2,399	3,626	(3,404)	1,260	2,189
Income Taxes	$		2	575	2,050	709	1,357	(1,624)	20	951
Net Profit or Loss	$		(155)	1,204	1,685	1,690	2,269	(1,780)	1,240	1,238
Total Scheduled Airline Industry										
Total Operating Revenues	$	573,849	697,879	771,262	839,920	1,019,672	1,165,612	1,313,284	1,437,805	1,634,707	1,861,175
Total Operating Expenses	$	595,492	674,992	727,692	763,578	892,578	1,059,923	1,205,689	1,312,146	1,490,836	1,727,677
Net Operating Income	$	(21,643)	16,887	43,570	76,342	127,094	105,689	107,595	125,659	143,877	133,498
Net Income Before Income Taxes[1]	$	(31,811)	7,215	26,078	74,044	125,559	119,374	121,978	130,717	159,807	155,842
Income Taxes	$	(5,407)	6,183	8,889	33,071	69,513	57,272	59,929	62,716	81,385	77,062
Net Profit or Loss	$	(26,404)	1,032	17,189	40,973	56,046	62,102	62,049	68,001	78,422	78,780

[1] Net income before taxes is adjusted for nonoperating items.
( ) Denotes red figures.
[2] Preliminary data.
[3] Seaboard and Western data not included in 1956.

ASSETS, LIABILITIES AND CAPITAL

U. S. Scheduled Airlines, *for selected years (in thousands of dollars)*

	1948	1950	1952	1954	1956[1]
Domestic Trunk Airlines					
Assets					
Current Assets	$171,860	203,952	344,115	358,375	406,956
Flight Equipment	$299,261	374,803	567,787	782,816	1,026,730
— Depreciation	$110,910	173,183	258,431	394,292	533,100
Flight Equipment—Net	$188,351	201,620	309,356	388,524	493,630
Ground Property and Equipment—Net	$ 73,722	59,265	76,506	90,371	121,972
Property and Equipment—Net	$262,073	260,885	385,862	478,895	615,602
Deferred Charges	$ 16,497	16,361	8,194	9,211	12,302
Other Assets	$ 33,811	61,341	37,593	38,035	126,493
Total Assets	$484,241	542,539	775,764	884,516	1,161,353
Liabilities and Capital					
Current Liabilities	$ 99,837	130,107	231,760	241,942	292,112
Long Term Debt	$167,404	135,842	168,247	185,093	262,956
Operating Reserves	$ 2,387	3,971	4,169	5,796	10,760
Capital Stock	$121,313	123,469	145,135	139,360	108,300
Capital Surplus	$ 60,573	64,644	89,028	91,845	165,144
Earned Surplus	$ 13,943	67,179	133,532	207,947	290,374
Other Liabilities	$ 18,784	17,327	3,893	12,533	31,707
Total Liabilities and Capital	$484,241	542,539	775,764	884,516	1,161,353

[1] Data for 1956 are as of Sept. 30th.

AVIATION WEEK

ASSETS, LIABILITIES AND CAPITAL *(continued)*

U. S. Scheduled Airlines, *for selected years (in thousands of dollars)*

	1948	1950	1952	1954	1956[1]
Local Service Airlines					
Assets					
Current Assets	$ 5,279	7,577	10,359	11,927	13,769
Flight Equipment	$ 5,671	10,056	16,404	17,693	25,806
— Depreciation	$ 2,396	5,020	6,788	9,873	12,384
Flight Equipment—Net	$ 3,275	5,036	9,616	7,820	13,422
Ground Property and Equipment—Net	$ 2,016	1,882	3,722	2,735	4,844
Property and Equipment—Net	$ 5,291	6,918	13,338	10,555	18,266
Deferred Charges	$ 1,349	1,743	1,209	1,018	1,161
Other Assets	$ 819	521	917	573	1,407
Total Assets	$ 12,738	16,759	25,823	24,073	34,603
Liabilities and Capital					
Current Liabilities	$ 3,333	6,542	10,346	10,666	16,446
Long Term Debt	$ 1,590	1,485	3,575	1,931	6,060
Operating Reserves	$ 105	287	357	616	1,119
Capital Stock	$ 4,832	6,938	7,218	6,720	6,799
Capital Surplus	$ 4,454	4,193	5,633	4,654	4,912
Earned Surplus	$ (1,665)	(2,815)	(1,821)	(556)	(889)
Other Liabilities	$ 89	129	515	42	156
Total Liabilities and Capital	$ 12,738	16,759	25,823	24,073	34,603
Territorial Airlines					
Assets					
Current Assets	$ 1,333	1,649	1,900	1,577	1,246
Flight Equipment	$ 2,411	2,300	4,338	6,354	5,994
— Depreciation	$ 1,261	1,653	2,277	2,899	3,046
Flight Equipment—Net	$ 1,150	647	2,061	3,455	2,948
Ground Property and Equipment—Net	$ 530	487	887	630	457
Property and Equipment—Net	$ 1,680	1,134	2,948	4,085	3,405
Deferred Charges	$ 85	72	268	161	151
Other Assets	$ 65	227	526	9	14
Total Assets	$ 3,163	3,082	5,642	5,832	4,816
Liabilities and Capital					
Current Liabilities	$ 486	466	1,601	1,751	1,444
Long Term Debt	$ 4		1,222	1,725	1,741
Operating Reserves	$ 62	47	79	84	54
Capital Stock	$ 1,845	1,845	2,775	2,776	1,981
Capital Surplus	$ 372	372	372	386	832
Earned Surplus	$ 305	278	(419)	(895)	(1,237)
Other Liabilities	$ 89	74	12	5	1
Total Liabilities and Capital	$ 3,163	3,082	5,642	5,832	4,816
Helicopter Airlines					
Assets					
Current Assets	$ 63	302	900	2,659	1,757
Flight Equipment	$ 297	528	1,371	2,285	3,845
— Depreciation	$ 94	285	385	1,176	1,646
Flight Equipment—Net	$ 203	243	986	1,109	2,199
Ground Property and Equipment—Net	$ 10	32	105	158	315
Property and Equipment—Net	$ 213	275	1,091	1,267	2,514
Deferred Charges	$ 89	71	263	145	169
Other Assets	$ 1	84	113	42	378
Total Assets	$ 366	732	2,367	4,113	4,818
Liabilities and Capital					
Current Liabilities	$ 97	69	430	656	481
Long Term Debt	$		138	204	711
Operating Reserves	$		4	33	50
Capital Stock	$ 294	695	816	899	677
Capital Surplus	$		974	1,998	2,201
Earned Surplus	$ (25)	(32)	5	309	698
Other Liabilities	$			14	
Total Liabilities and Capital	$ 366	732	2,367	4,113	4,818

[1] Data for 1956 are as of Sept. 30th.

( ) Denotes red figures.

U. S. Scheduled Airlines, *for selected years (in thousands of dollars)*

	1948	1950	1952	1954	1956[1]
International and Overseas Airlines					
Assets					
Current Assets	$ 71,748	93,957	79,437	99,695	108,420
Flight Equipment	$ 94,782	133,489	164,524	193,798	256,410
— Depreciation	$ 32,398	55,495	76,243	91,061	110,371
Flight Equipment—Net	$ 62,384	77,994	88,281	102,737	146,039
Ground Property and Equipment—Net	$ 15,030	12,231	12,775	13,380	15,941
Property and Equipment—Net	$ 77,414	90,225	101,056	116,177	161,980
Deferred Charges	$ 24,909	25,688	20,706	4,685	4,541
Other Assets	$ 30,403	9,190	16,554	21,273	38,746
Total Assets	$204,474	219,070	217,753	241,770	313,687
Liabilities and Capital					
Current Liabilities	$ 31,477	52,623	66,986	81,341	92,356
Long Term Debt	$ 5,800	41,250	27,955	29,575	72,379
Operating Reserves	$ 5,438	5,776	6,314	3,637	4,136
Capital Stock	$ 7,665	10,766	10,895	13,068	13,777
Capital Surplus	$ 30,518	62,828	62,828	62,880	63,338
Earned Surplus	$ 18,691	26,024	33,584	47,184	60,690
Other Liabilities	$104,885	19,803	9,191	4,085	7,011
Total Liabilities and Capital	$204,474	219,070	217,753	241,770	313,687
Alaskan Airlines					
Assets					
Current Assets	$ 3,203	2,800	4,141	4,591	7,897
Flight Equipment	$ 4,146	4,629	5,856	8,251	11,186
— Depreciation	$ 1,743	3,125	4,026	5,307	5,390
Flight Equipment—Net	$ 2,403	1,504	1,830	2,944	5,796
Ground Property and Equipment—Net	$ 1,197	1,125	2,212	2,225	2,700
Property and Equipment—Net	$ 3,600	2,629	4,042	5,169	8,496
Deferred Charges	$ 177	130	230	172	254
Other Assets	$ 262	281	255	347	532
Total Assets	$ 7,242	5,840	8,668	10,279	17,179
Liabilities and Capital					
Current Liabilities	$ 2,685	2,571	4,878	3,449	6,255
Long Term Debt	$ 408	475	1,634	1,419	3,581
Operating Reserves	$ 175	313	388	342	777
Capital Stock	$ 1,746	1,833	2,258	2,680	2,932
Capital Surplus	$ 3,256	3,248	3,121	3,800	3,610
Earned Surplus	$ (1,073)	(2,626)	(3,648)	(1,593)	(103)
Other Liabilities	$ 45	26	37	182	127
Total Liabilities and Capital	$ 7,242	5,840	8,668	10,279	17,179
All Cargo Airlines					
Assets					
Current Assets		$5,822	9,072	8,138	21,125
Flight Equipment		$2,631	8,661	20,921	31,003
— Depreciation		$ 838	2,264	6,212	9,459
Flight Equipment—Net		$1,793	6,397	14,709	21,544
Ground Property and Equipment—Net		$ 508	1,468	1,356	2,376
Property and Equipment—Net		$2,301	7,865	16,065	23,920
Deferred Charges		$ 422	395	335	1,543
Other Assets		$ 381	3,016	281	20,292
Total Assets		$8,926	20,348	24,819	66,880
Liabilities and Capital					
Current Liabilities		$3,682	7,320	6,103	16,895
Long Term Debt		$1,531	3,443	7,345	16,887
Operating Reserves		$ 321	386	1,598	2,081
Capital Stock		$4,183	6,360	6,401	10,382
Capital Surplus		$3,135	1,732	2,352	11,992
Earned Surplus		$3,971	981	968	7,183
Other Liabilities		$ 45	126	52	1,460
Total Liabilities and Capital		$8,926	20,348	24,819	66,880

[1] Data for 1956 are as of Sept. 30th.

ASSETS, LIABILITIES AND CAPITAL *(continued)*

U. S. Scheduled Airlines, *for selected years (in thousands of dollars)*

	1948	1950	1952	1954	1956[1]
Consolidated Industry					
Assets					
Current Assets	$ 253,486	316,069	449,924	486,962	561,170
Flight Equipment	$ 406,568	528,436	768,941	1,032,118	1,360,974
— Depreciation	$ 148,802	239,599	350,414	510,820	675,396
Flight Equipment—Net	$ 257,766	288,837	418,527	521,298	685,578
Ground Property and Equipment—Net	$ 92,505	75,530	97,675	110,885	148,605
Property and Equipment—Net	$ 350,271	364,367	516,202	632,153	834,183
Deferred Charges	$ 43,106	44,487	31,265	15,727	20,121
Other Assets	$ 65,361	72,025	58,974	60,560	187,862
Total Assets	$ 712,224	796,948	1,056,365	1,195,402	1,603,336
Liabilties and Capital					
Current Liabilities	$ 137,915	196,060	323,321	345,908	425,989
Long Term Debt	$ 175,206	180,583	206,214	227,292	364,315
Operating Reserves	$ 8,167	10,715	11,697	12,106	18,977
Capital Stock	$ 137,695	149,729	175,457	171,904	144,848
Capital Surplus	$ 99,173	138,420	163,688	167,915	252,029
Earned Surplus	$ 30,176	84,037	162,214	253,364	356,716
Other Liabilities	$ 123,892	37,404	13,774	16,913	40,462
Total Liabilities and Capital	$ 712,224	796,948	1,056,365	1,195,402	1,603,336

[1] Data for 1956 are as of Sept. 30th.

INTERCITY PASSENGER MILE MARKET

Common Carriers and Private Automobile, *1947-1956*

(Millions of Passenger Miles)

	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956[1]
Pullman & Air Travel										
Rail Pullman (Class I)	12,261	11,015	9,349	9,338	10,226	9,504	7,950	6,850	6,441	6,319
Domestic Trunk Lines	6,016	5,822	6,571	7,766	10,211	12,121	14,298	16,246	19,218	21,643
Local Service Airlines	46	88	135	189	290	340	391	450	523	633
Pullman and Air Combined	18,323	16,925	16,055	17,293	20,727	21,965	22,639	23,546	26,182	28,595
Airline % of Combined Total	33.08	34.92	41.77	46.00	50.66	56.73	64.88	70.91	75.40	77.90
Other Common Carriers										
Rail Coach (Class I, ex. commutation)	27,660	24,315	20,273	17,443	19,524	19,758	18,955	17,687	17,314	17,054
Intercity Motor Bus Lines (Class I, II, III)	23,948	23,529	22,411	21,254	22,299	21,223	19,634	16,934	16,489	16,448
Total	51,608	47,844	42,684	38,697	41,823	40,981	38,589	34,621	33,803	33,502
Total Common Carrier	69,931	64,769	58,739	55,990	62,550	62,946	61,228	58,167	59,985	62,097
% Airline of Common Carrier	8.67	9.12	11.42	14.21	16.79	19.80	23.99	28.70	32.91	35.87
Private Intercity Automobile[2]	272,958	287,423	376,313	402,843	457,787	495,547	529,194	548,763	585,800	621,000
Total Common and Private Carrier	342,889	352,192	435,052	458,833	520,337	558,493	590,422	606,930	645,785	683,097
Passenger Miles per Capita[3]	2,381	2,403	2,916	3,025	3,371	3,557	3,699	3,737	3,907	4,064

[1] Partly Estimated
[2] Revised from 1949
[3] Not in Millions

REVENUE PASSENGERS CARRIED

U. S. Scheduled Airline Industry, *1947-1956 (in Thousands of Passengers)*

	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956
Domestic Trunk Airlines	12,279	12,324	14,021	15,978	20,621	22,759	26,137	29,526	34,511	37,598
Local Service Airlines	236	426	678	969	1,481	1,736	2,032	2,423	2,897	3,453
Territorial Airlines	376	418	382	477	550	515	553	561	591	627
Helicopter Airlines							1	9	29	62
International and Overseas Airlines	1,360	1,373	1,520	1,675	2,033	2,362	2,682	2,888	3,376	3,888
Alaskan Airlines[1]		111	122	144	157	194	220	225	264	315
Total Scheduled Airline Industry	14,251	14,652	16,723	19,243	24,842	27,566	31,625	35,632	41,623	45,943

[1] Alaskan data for 1948 thru 1950 includes charter flights

AVERAGE PASSENGER FARE

Intercity Common Carriers, *1947-1956 (in Cents per Mile)*

	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956[3]
Domestic Scheduled Airlines[1]										
Coach or Tourist			3.96	4.10	4.45	4.18	4.13	4.34	4.32	4.31[3]
All Services	5.04	5.75	5.75	5.54	5.59	5.54	5.43	5.37	5.32	5.30
Int'l Scheduled Airlines										
Coach or Tourist							5.77	5.83	n.a.	n.a.
All Services	7.77	8.01	7.72	7.28	7.13	7.05	6.87	6.79	6.69	6.70
Intercity Railroads										
First Class	2.74	3.01	3.14	3.25	3.27	3.35	3.38	3.35	3.31	3.38
Coach	2.02	2.29	2.41	2.47	2.47	2.53	2.53	2.50	2.47	2.55
Intercity Motor Busses	1.70	1.74	1.84	1.88	1.94	2.02	2.05	2.07	2.06	2.07

[1] Includes trunk, local service and territorial airlines.
[2] Partly estimated.
[3] Fiscal 1956.
n.a.—Not available.

AVIATION WEEK

NEW TYPES OF AIRCRAFT IN SCHEDULED SERVICE

U. S. Domestic and International Airlines—*Operated as of December 31, 1956 and Cumulative Inventory Including Aircraft on Order through 1961*

Aircraft Type	Number In Service 12/31/56	1957	1958	1961
Boeing: 707*				70
Bristol: Britannia*			5	5
Convair: 440	19	43	43	43
880*				40
deHavilland: Comet IV*			6	14
Douglas: DC-6A, B & C	186	253	270	270
DC-7, B & C	132	211	253	253
DC-8*				89
Fairchild: Friendship*		16	31	31
Frye: Safari		6	8	8
Lockheed: Constellation, G & H	32	51	51	51
L-1649		25	25	25
Electra*			27	116
Vickers: Viscount*	54	74	89	92

* Jet Powered.

AIRCRAFT OPERATED

by U. S. Scheduled Airline Industry *as of December 31, for Selected Years*

Aircraft Type	Aircraft Used Wholly in Domestic Operations[1]				Aircraft Used Wholly in International and Overseas Oper.				Aircraft Used in Both Domestic and International Operations[2]			
	1946	1952	1954	1956	1946	1952	1954	1956	1946	1952	1954	1956
Boeing: 247-D	4											
307-B	5				3							
377			11			28	27	25		16	10	9
Convair: 240		22	16	22		14	10	5		77	76	73
340		7	84	86		1	5	5			32	32
440				8								11
Douglas: DC-3	460	343	259	282	78	56	56	50		20	24	24
DC-4	150	80	71	61	42	50	39	48	8	55	45	34
DC-6 /6A /6B		65	72	99		32	62	70		98	117	130
DC-7 /7B			20	4				33			41	95
Lockheed:												
Electra	3											
Ladestar	11	11									11	10
Constellation	4	51	53	52	23	14	9	9	8	50	49	56
Super Const.		10	10	33				2		14	29	44
Martin: 202		21	25	23								
404		96	100	97								
Vickers Viscount				54								
Total	647[3]	706	711	821	146	195	208	247	16	330	434	518

[1] Includes Domestic Trunk and Local Service Carriers.
[2] Trunk Airlines who operate both Domestic and International Routes usually have their aircraft certificated for both operations in order use these aircraft internationally.
[3] Total Domestic for 1946 includes 10 Stinsons.

Helicopters:				
Bell: 8-47	6	6	7	
Sikorsky: S-51	3	3	2	
S-55	5	11	8	
S-58			3	
Total	14	20	20	

April 29, 1958

AIRCRAFT OPERATIONS AT CAA AIRPORT TOWERS

1947-1956 (in Thousands)

	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956[1]
Type of Flight Operation										
Military	1,595	2,259	2,780	2,384	2,852	2,983	3,712	4,409	4,975	5,075
Civil	13,221	12,877	10,446	9,585	9,618	7,965	7,719	8,015	8,540	9,107
Air Carrier	2,854	3,242	3,713	4,002	4,556	4,866	5,384	5,512	5,983	6,202
Total	17,670	18,378	16,939	15,971	17,026	15,814	16,815	17,945	19,480	20,384
% Air Carrier of Total	16.2	17.6	21.9	25.1	26.8	30.8	32.0	30.8	30.7	30.4

NOTES: Air Carriers include scheduled and non scheduled operations.
Each landing is counted as an operation as is also each takeoff.
[1] Fiscal Year.

COMPARATIVE TRANSPORT SAFETY RECORD

Passenger Fatality Rate *per 100,000,000 Passenger Miles, 1947-1956*

	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956
Domestic Scheduled Airlines										
Fatalities	199	83	93	96	142	46	86	16	156	144
Rate	3.28	1.40	1.39	1.21	1.35	.37	.59	.10	.79	.64
International and Overseas Scheduled Airlines[1]										
Fatalities	20	20	4	48	43	94	2	0	2	10
Rate	1.08	1.02	.19	2.10	1.59	2.98	.06		.04	.19
Motor Buses										
Fatalities	140	120	120	100	130	100	70	60	100	n.a.
Rate	.21	.18	.20	.17	.22	.16	.13	.11	.19	n.a.
Railroad Passenger Trains										
Fatalities	75	52	29	184	150	14	50	23	19	52 p.
Rate	.16	.13	.08	.58	.43	.04	.16	.08	.07	.19 p.
Passenger Autos and Taxis										
Fatalities	15,300	15,200	15,300	17,600	21,000	22,600	23,500	22,500	24,700	n.a.
Rate	2.3	2.1	2.0	2.2	2.4	2.8	2.9	2.6	2.7	n.a.

[1] Alaska data not included for 1947.
n.a.—Not Available.
p.—Preliminary.

AVIATION WEEK

CLASSES OF UNITED STATES COMMERCIAL AIR CARRIERS

At the present time there are seven recognized classes of air carriers in the air transport industry of the United States. This classification is used by the Civil Aeronautics Board in connection with the economic regulation of the industry and under the Civil Aeronautics Act is based largely on the scope of operations authorized or allowed by that Act. Classes One to Six have certificates of convenience and necessity and conduct regularly scheduled services.

1. The Domestic Trunk Lines include those air carriers which presently have permanent operating rights within the continental United States. These rights derive largely from operations by present or predecessor companies antedating the Civil Aeronautics Act of 1938 which granted them "grandfather rights." There are currently twelve trunk lines, most of which operate high-density traffic routes between the principal traffic centers of the United States.

American	Continental	National	Trans World
Braniff	Delta	Northeast	United
Capital	Eastern	Northwest	Western

2. The Domestic Local Service Lines have, with one exception, been certificated since 1945. These carriers operate routes of lesser traffic density between the smaller traffic centers and between these centers and principal centers. The thirteen local service lines in 1955 were:

Allegheny	Lake Central	Ozark	Southwest
Bonanza	Mohawk	Piedmont	Trans Texas
Central	North Central	Southern	West Coast
Frontier			

3. The International and Overseas Lines include all U. S. flag air carriers operating between the United States and foreign countries other than Canada. Some of these carriers conduct operations between foreign countries and some are extensions of domestic trunk lines into Mexico and the Caribbean.

Alaska	Eastern	Pacific Northern	South Pacific [2]
American	Mackey [2]	Pan American	Trans World
Braniff	National	Pan American-Grace	U. M. C. A. [2]
Caribbean Atlantic	Northwest	Resort [1]	United
Delta		Samoan [2]	

4. The Territorial Lines include two groups of carriers. The Insular Lines operate in the U. S. Island possessions in the Pacific and the Caribbean and the Alaskan Lines operate between the U. S. and Alaska and within Alaska.

Insular Lines

Hawaiian	Alaska	Pacific Northern
Trans-Pacific	Northwest	Pan American

Alaskan Lines

Operating between the U. S. and Alaska	Operators within Alaska
Alaska	Howard J. Mays
Alaska Coastal	Northern Consolidated
Bristol Bay	Pacific Northern
Cordova	Pan American
Ellis	Reeve Aleutian
	Wien

5. The Helicopter Airmail Lines presently operate between airports, central post offices, and suburbs in New York, Chicago and Los Angeles. Originally certificated as exclusive mail carriers they now fly passengers, air freight and air express. These carriers hold temporary certificates and are considered to be experimental in nature.

Chicago Helicopter Airways · Los Angeles Airways · New York Airways

6. The All Cargo Lines operate under temporary certificates authorizing scheduled cargo flights between designated areas in the U. S., and in one case to the Caribbean and in another to Europe. These carriers cannot carry either regular air mail or passengers.

Aerovias Sud Americana	Flying Tigers	Seaboard & Western
American Air Export and Import	Riddle	Slick

7. Non-Certificated Air Carriers include a diversified group of operators who, with the exception of the air taxi operators and air freight forwarders, are not authorized to engage in regularly scheduled service. They are described in the CAB 1954 Annual Report as follows:

Operators of various types of air services have been authorized by the Board through the exemption process, rather than through the requirement that a certificate of convenience and necessity be obtained. At present this group includes:

Supplemental and irregular transport carriers	49
Air freight forwarders	80

[1] Certificated cruise carrier.

[2] Certificated non-mail carriers.

[1, 2] Statistical data of these carriers are not included in the statistical tables.

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18TH EDITION
Facts and Figures, 1957

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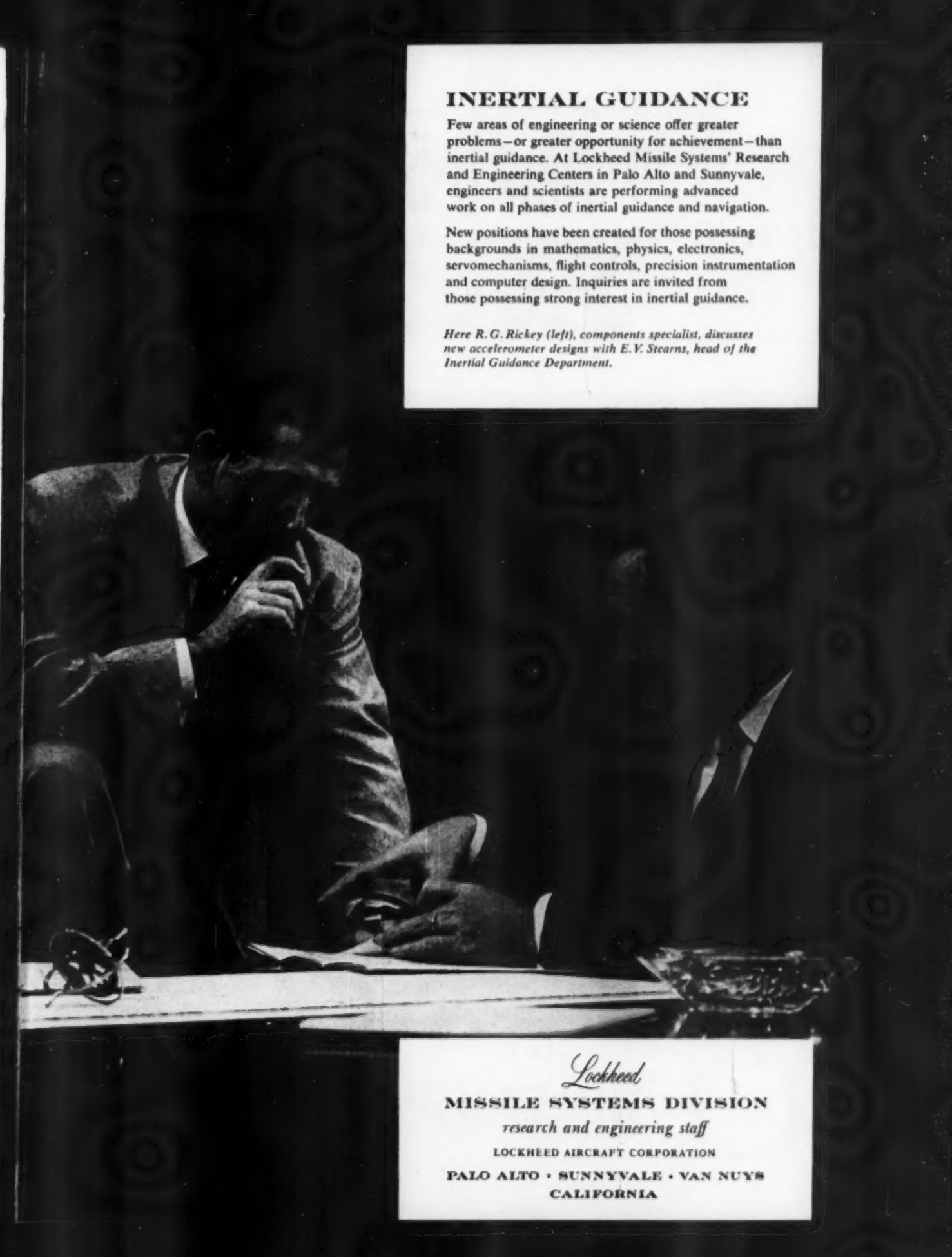

INERTIAL GUIDANCE

Few areas of engineering or science offer greater problems—or greater opportunity for achievement—than inertial guidance. At Lockheed Missile Systems' Research and Engineering Centers in Palo Alto and Sunnyvale, engineers and scientists are performing advanced work on all phases of inertial guidance and navigation.

New positions have been created for those possessing backgrounds in mathematics, physics, electronics, servomechanisms, flight controls, precision instrumentation and computer design. Inquiries are invited from those possessing strong interest in inertial guidance.

Here R. G. Rickey (left), components specialist, discusses new accelerometer designs with E. V. Stearns, head of the Inertial Guidance Department.

Lockheed

MISSILE SYSTEMS DIVISION

research and engineering staff

LOCKHEED AIRCRAFT CORPORATION

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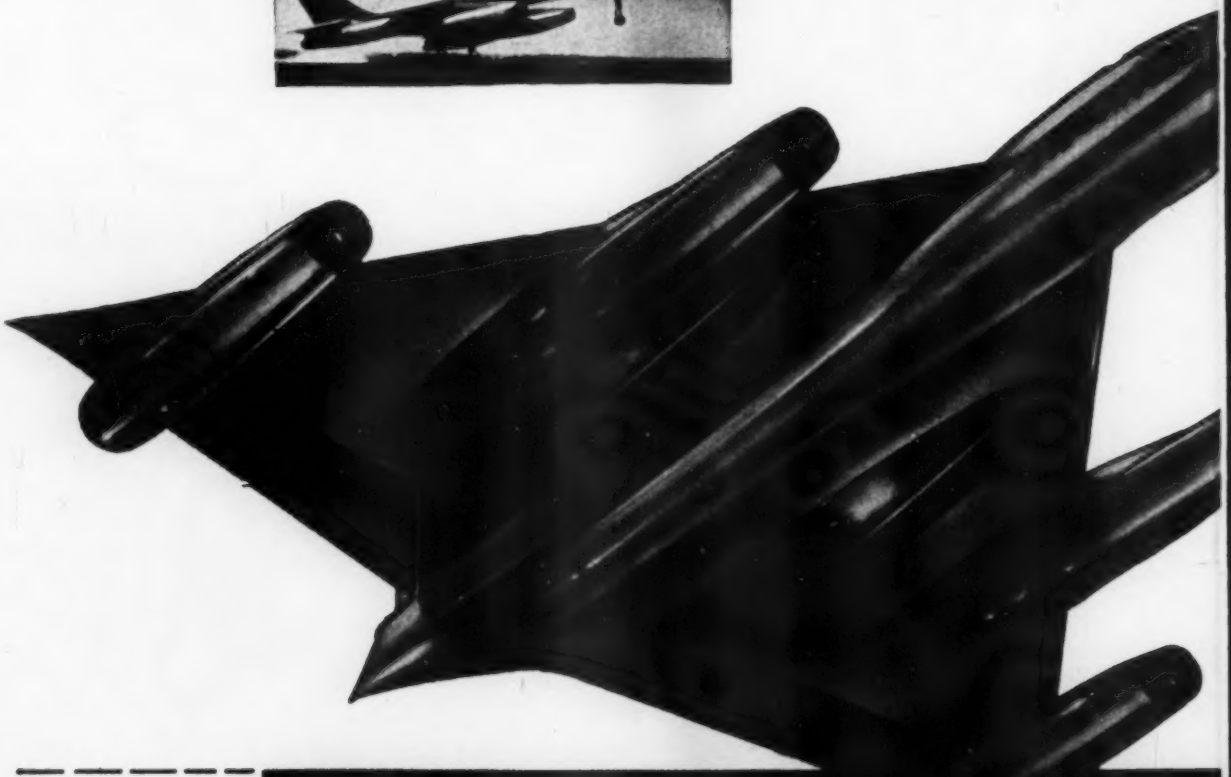
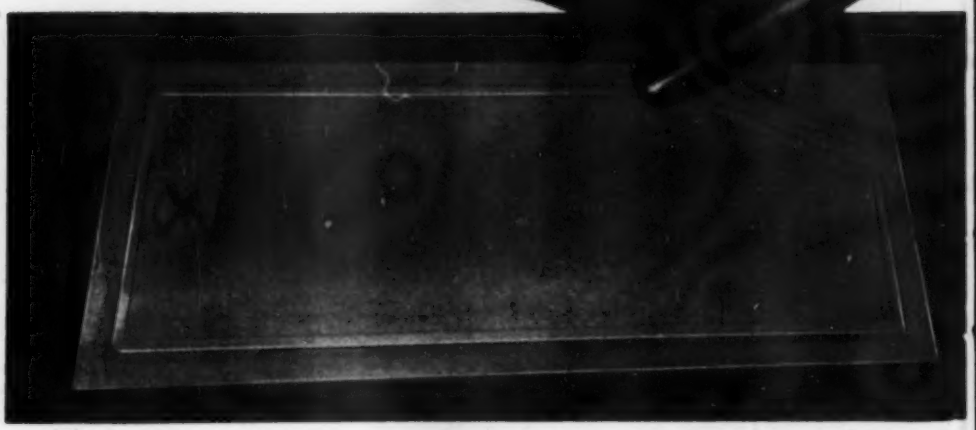
New B-58 America's





Typical brazed stainless steel honeycomb sections used in the B-58. Both core and cover sheets are Armco 17-7 PH Stainless.

Sheffield Steel Division
Armco Drainage & Metal Products, Inc.
The Armco International Corporation

ARMCO

First Supersonic Bomber...

gets Heat-Resistance, High Strength from ARMCO 17-7 PH STAINLESS

Components of Convair's new "Hustler" made of Armco 17-7 PH Stainless to assure strength in "hot spots."

Powered by four afterburner jets, the B-58 is designed to sweep through the sky at supersonic speeds. This new delta-winged Convair bomber is a potent addition to American air power. Its design demanded high performance aircraft materials, especially for highly stressed parts subject to both aerodynamic and jet engine heat.

Because of this, Convair engineers specified Armco 17-7 PH Stainless Steel in parts where operating temperatures are critical. By using this special stainless steel for brazed honeycomb sections as well as formed structural elements, they obtained the required strength, lightness and resistance to heat.

Offers Formability Plus High-Temperature Strength

On a strength-weight basis at temperatures up to 900 F, Armco 17-7 PH is one of the strongest aircraft materials available. Guaranteed minimum room-temperature tensile properties of **180,000 psi** ultimate and **150,000 psi** 0.2% yield in Condition TH 1050, and **200,000** and **180,000 psi** in Condition RH 950, assure a reliable design basis.

Besides excellent mechanical properties, Armco 17-7 PH possesses exceptionally good workability. In the annealed condition it can be readily stretch- or press-formed, drawn and welded. Then, after fabrication, its high mechanical properties are fully developed by a simple heat treatment.

Widely Used

Because of its unusual combination of properties —high strength, resistance to heat, excellent fabricating characteristics and corrosion resistance —Armco 17-7 PH Stainless is widely used in supersonic jets and long range missiles.

Consider how the advantages of this unique stainless steel, available in sheet, strip, wire and plate, can be utilized to help solve **your** design and production problems. For information on the properties and fabrication of Armco 17-7 PH Stainless Steel, write us at the address below.

(Note: A companion grade, Armco 17-4 PH, is supplied in bar and forging billets.)

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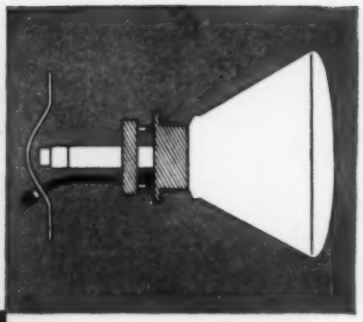

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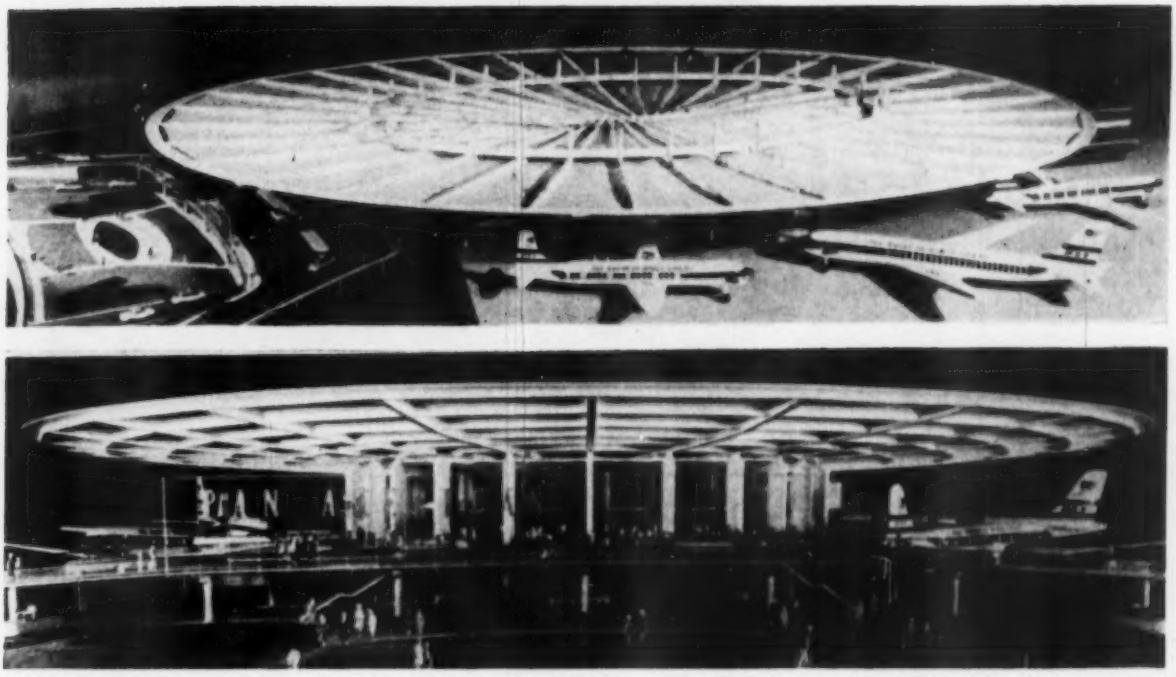

SCALE MODEL shows how Pan Am terminal would be approached from one of eight lanes allowed for vehicular traffic. Terminal would handle over 1,000 cars or taxis an hour. Passengers would unload on second floor level, proceed under cantilever roof to plane.

Pan Am Plans "Umbrella" Terminal

By George L. Christian

New York—Air terminal of completely new concept, designed to handle a fully-loaded 160-passenger airliner every 15 minutes, will be erected by Pan American World Airways at New York International Airport.

The $8-million structure, to be built at the right side of the International Arrival Building, features slim concrete columns supporting a huge umbrella-like cantilever roof with a 110-ft. overhang under which departing and arriving planes will be stationed. Glass walls on all four sides provide unrestricted view in all directions. The structure will cover an area of four acres.

Cantilever roof construction will use an exposed steel cable suspension system similar to that of Pan American's new hangar being built at Idlewild. Trans World Airlines has moved into a hangar at Kansas City whose roof is steel cable-supported, and a second, similar hangar is under construction at Idlewild, indicating a trend to steel cable-supported structures in the airline industry (AW Jan. 7, p. 107).

TWA will erect its terminal on the left of the International Arrival Building.

It will not yet reveal its plans for the building which, it claims, will be super-modern.

PAA's terminal will serve primarily as a departure terminal. Only arrivals to use the facility will be those passengers who do not have to clear through customs and immigration—such as arrivals from Puerto Rico. Planes carrying passengers who have to clear customs will use the International Arrival Building.

Purely Functional

The structure, purely functional in design, climinates two common major defects of most large airline terminal buildings: requiring passengers to walk long distances through deadly "sheep-runs" to get to planes; and being exposed to wind and weather while trudging from terminal to plane.

PAA's solution to these two vexing problems:

- **Broaden the finger** into an overall terminal large enough to accommodate six four-engine airliners. A spillover area, provided at one end of the oval, is capable of accommodating one or two additional planes in case of an unforeseen jam-up. With such an arrangement, passengers can emplane directly from a comfortable lounge.
- **Place over the terminal** a mushroom-like roof with giant eaves extending 110 ft. over the plane parking area, permitting passengers, luggage, cargo and mail to be loaded under cover.

Idea Borrowed

PAA borrowed and bettered the cantilever roof feature from Berlin's Tempelhof Field Terminal which was built in the early thirties. Additional cost for such a design over a conventional terminal is about $2-million, according to Harold E. Gray, executive vice president of Pan Am's Atlantic Division.

Here is how the terminal will streamline a departing passenger's arriving and boarding procedure:

Passengers arriving by limousine or car are brought to the second floor of the terminal. Eight, 150-ft. vehicular lanes are provided to accommodate about 1,800 cars an hour.

Usual, heavy entrance doors which passengers have to shove open with their hands full of baggage, have been eliminated. Instead, a 100-ft. wide "curtain of air," which flows downward from overhead ducts to slots in the floor, will keep terminal temperatures at the desired level.

PAA will provide 48 check-in positions to eliminate weighing-in delays. Positions will be within 40 ft. of the

THE ERA OF THE ELAND IS BEGINNING...

The case for ELAND conversion

To forward-looking operators of medium-haul airlines the case for ELAND conversion becomes clearer and more convincing month by month. Increasingly they see that ELANDS point the way to the achievement of better performance, greater earning capacity, and greater dependability in service from well-proven airframes.

No beat, whine or whistle

ELANDS possess to the full that inherent asset of the turbo-prop—a greatly reduced noise level. And over and above this they have an inherent asset of their own—a complete absence of beat, whine or whistle. The passenger appeal implicit in this needs no emphasis.

Flexibility of power

ELAND design provides a wide range of power in a one-sized package. The 3,000-4,200 e.h.p. range of ELAND engines differ nothing in size and only little in overall weight. This flexibility will enable operators to standardize on one basic engine and nacelle design where two or three different types of piston engines are now required.

Conversion of the Convair 340

The Napier Eland Convair—a Convair 340 which we bought from the makers and converted to ELANDS—has proved the simplicity of ELAND installation, the low cost of conversion and the increased profits that accrue from ELAND operation.

From studies made of the published direct operating costs (including depreciation) of a number of typical airlines, it is proved that in the light of our guarantees a converted aircraft will be cheaper to operate—whether the costs are calculated on the basis of aircraft miles, ton miles or passenger miles. The ELAND-engined Convair 340 can carry its maximum payload 930 miles further than piston-engined Convairs, and its cruising speed is 50 m.p.h. higher.

In short, we offer to operators of the Convair—and other medium-haul 'planes—an airliner with a new lease of life at a cost which will be written off over a relatively short period. That is the essence of the case for ELAND conversion.

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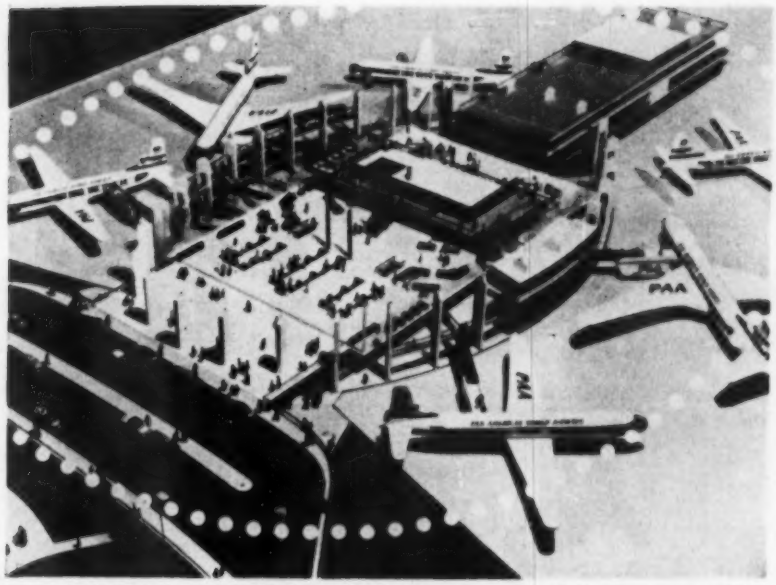
Three examples of successful Napier Eland conversions: the Convair 340, the Elizabethan, the Varsity.



ALL AIRCRAFT will be visible from the lounges of new terminal. Four acres will be under roof; 48 check-in positions will be within 40 feet of the terminal entrance.

terminal entrance to save passengers having to carry their luggage any great distance.

Main waiting room on the second floor will have over 500 lounge seats compared to the 358 seats currently available for all airlines at La Guardia Field.

Restaurant, coffee shop, bar, observation deck and additional lounges will be on a mezzanine straddling the main concourse.

Enplane From Second Floor

Passengers will emplane from the terminal's second floor to the planes' cabin level on raised passageways. This eliminates walking through the grease and water puddles so often present on airport aprons, and climbing steep stairs into the plane.

Passageways are mounted on self-propelled "truck-ramps" which will be specially built for Pan Am. Contract has not been let.

Other advantage of the second floor-to-plane boarding procedure is that the terminal's ramp is left entirely to aircraft service personnel who can therefore perform their jobs, such as loading and unloading baggage, much more quickly and efficiently.

For arriving passengers, PAA has established a specification that no one will have to wait more than five minutes for his luggage.

Gray told AVIATION WEEK that jet transports will taxi into position at the terminal, but will be towed away from the terminal to originate a flight or go to the hangar. Reason is to avoid the noise and jet blast under the overhanging eaves. Also, it would not be practical to maneuver jets so close to other aircraft while under their own power.

When asked what Pan American planned to do with the terminal if the Port of New York Authority persisted in its current ban of jets at Idlewild, Gray replied, "This building could make the fanciest supermarket you have ever seen."

The air-conditioned structure, to be erected on a 17-acre site, will contain approximately 100,000 sq. ft. of floor space, about half of which will be devoted to passenger facilities.

The building, which will be completed late in 1958, was designed by Tippetts, Abbett, McCarthy and Stratton, New York architectural and engineering firm. Associate architects were Ives, Turano and Gardner.

Engineer: Arresters For Jets Feasible

"Safety arresters to accommodate commercial jet aircraft are feasible at the present time," Charles J. Daniels of All American Engineering Co., recently told the aeronautic meeting of the Society of Automotive Engineers.

"Development of aircraft arrestment equipment for the military during recent years has extended the state of the art into an area which exceeds the requirements for commercial safety overrun arresters."

Daniels said that the water squeezer is an ideal arresting engine for use with commercial jets with weights ranging from 100,000-300,000 lm. and landing speeds up to 120 kt.

Advantages of the system are:

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Continental Air Lines introduces the **first** scheduled all DC-7B service between Chicago and Los Angeles... the **only** service to combine the finest in-flight luxuries with all-new DC-7Bs and low aircoach fares... the DC-7B CONTINENTAL CLUB COACH!

The Continental Club Coach features a 5-seat Club Lounge... reserved seats... hot "Country Club" meals (choice of 4 entrees) and cocktails at moderate cost—children's meals at reduced prices... unique Stag Smoker Lounge, and many other luxury features ... plus **DC-7Bs on every flight!**

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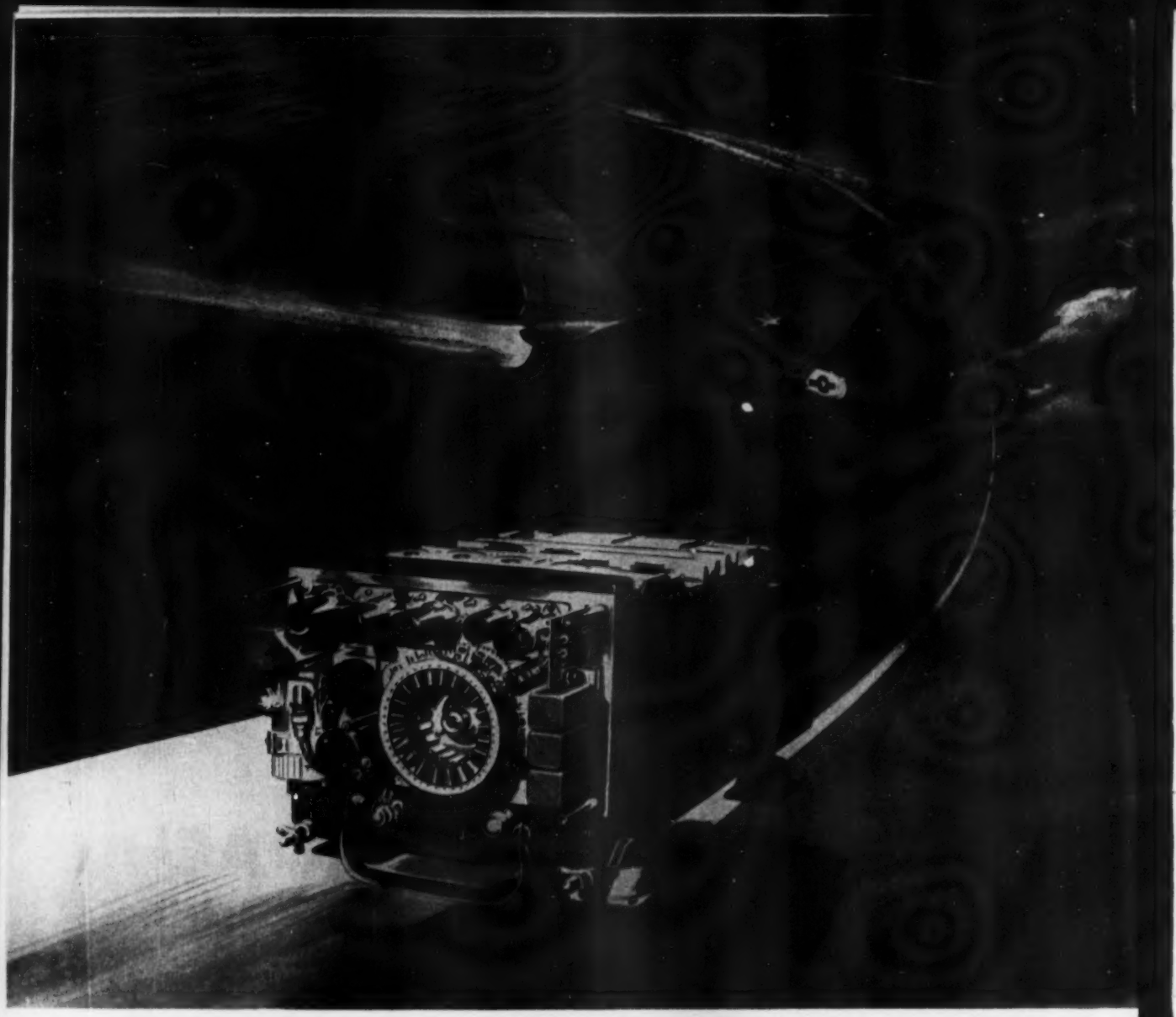
CONTINENTAL AIR LINES



TACAN unit shown with covers removed; plane is a composite model.

78-~~page~~ tube road map for jets

An 800-foot carrier may be as hard to find as a needle in a haystack, when the plane seeking it is at 20,000 feet and the time is 0200 hours.

To make the homing plane a homing pigeon, we build the "ARN-21" TACAN equipment illustrated above. Its 78 tubes and associated components add up to a self-contained transmitter and receiver, rugged in its ride-resistance and accurate to pin-point tolerances.

The manufacture of equipment as important and complicated as this demands *perfection*, and nothing less. On the military as well as the home front, Stromberg-Carlson has long displayed the ability to take such problems in stride.

STROMBERG-CARLSON COMPANY

A DIVISION OF GENERAL DYNAMICS CORPORATION

General Offices and Factories at Rochester, N. Y.—West Coast plants at San Diego and Los Angeles, Calif.

• **Machine requires** no adjustments regardless of speed or weight—provided they are within design limits.
• **Diameter** of water-filled tubes, through which pistons are pulled, can be a varied to program retarding force and stopping distance to desired values.
• **Pre-set or stored** high pressure air or water charges—which might leak and cause malfunctioning—are not needed.
• **Underground installation** would remove the engine as an airport obstacle. This would also reduce possibility of water freezing. If necessary, anti- freeze may be added without affecting the engine's operation.
• **Resetting the water** squeezer is inexpensive and fast.

All American Engineering has made a preliminary design of a water squeezer for use with jet commercial aircraft weighing from 100,000-300,000 lb. and engaging at speeds of ranging from 0-120 kt. Here are some of the data: cable dia.—1¼ in.; piston dia.—13 in.; tube length—875 ft.; tube max. dia.—21 in.; min. dia.—13.5 in.; working pressure—800 psi.

Such an engine would stop these aircraft in 1,000 ft.: plane weighing 300,000 lb. landing at 120 kt. and imposing .8G; plane weighing 100,000 lb., landing at 120 kt. and imposing 1 5G.

Retraction time for the cable is about 15 min.

Temco Orders New Ejection Seat Type

Los Angeles—Hardman Tool and Engineering Co., Los Angeles, has received initial order for 50 new type ejection seats from Temco Aircraft Corp. Seats are scheduled for installation in Temco's TT-1 primary jet trainer.

They are first of this type to use the integrated ejection seat system developed by Navy and Douglas Aircraft's El Segundo division.

Design eliminates need for adjustable head and foot rests. Integrated pilot restraint system attaches to shoulder harness inertia reel which allows pilot freedom of movement, yet assures immediate arrest of forward movement, plus instant separation following ejection or ditching.

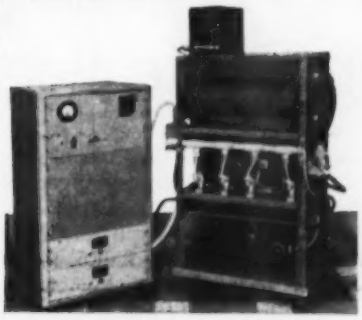
System has undergone extensive testing. Seat is designed for 25G ejection load and 40G crash load. It has withstood 60G deceleration in tests.

Pesco Products Goes to Accessories Exclusively

Pesco Products Division, Borg-Warner Corp., will devote its energies exclusively to engineering and production of aircraft accessories. The former Industrial Division has released 312,631 square feet of floor space at the Pesco Bedford, O. plant for the production of such aircraft accessories as fuel and fuel booster pumps, hydraulic pumps, air pumps and electrical accessories for military and commercial planes.

DYNAMIC ALTITUDE SIMULATOR

FOR TEST AND EVALUATION OF FLIGHT CONTROL EQUIPMENT AND INSTRUMENTS



Simulates actual altitude conditions of high performance aircraft or missiles in flight

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Max rate— 50,000 ft/min
Max response 10 cps

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Every day at ROCKETDYNE'S Propulsion Field Laboratory, deep in California's Santa Susana Mountains near Los Angeles, rocket engines developing millions of jet horsepower are tuned and tested for their ultimate job—to power America's long-range missiles.

These high-thrust engines—developing more propulsive power than anything before produced—are moving on schedule from ROCKETDYNE for delivery to the Armed Forces. By fall of this year other high-thrust production engines will flow from another plant now being activated by ROCKETDYNE in Neosho, Missouri.

As today's engines are being delivered, ROCKETDYNE engineers are constantly pushing ahead—evolving dramatic boosts in power outputs and engine performance.

This kind of tomorrow-minded engineering—conducted in a private enterprise system—is a keystone in the defense structure of the free world.

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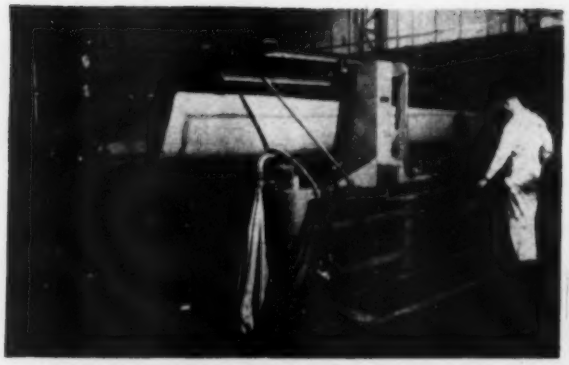
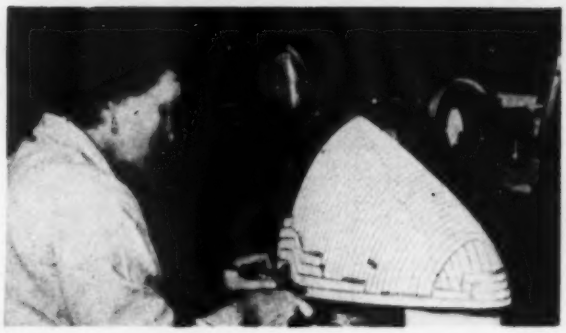
CANOGA PARK, CALIF. & NEOSHO, MO. • A DIVISION OF NORTH AMERICAN AVIATION, INC.





SPRAYMAT APPLIED to Britannia elevator horn balance undergoing element uniformity checks (left). Special rig for mechanically spraying the elements of the Britannia tail unit heaters (above left). Functional testing a fin leading edge heater, using water cooler (right).

Flame-Sprayed Elements Aid Britannia Tail Surface De-Ice

London—De-icing system originally applied only to the elevator horn balances of the Bristol Britannia proved so effective and simple it also was adopted for leading edges of the fin and tailplane.

The electrical heater system—"Spraymat"—consists of flame-sprayed metal elements sandwiched between layers of insulating material, the base insulation acting as an adhesive to secure the heater to the component.

Two main types are in use. Both employ flame-sprayed conductor elements of either aluminum or Kumanal, and sprayed copper busbars to carry the current from one element to the next at each change of direction.

Spraymat Type 1 heaters employ a flame-sprayed insulation compound which is oven-cured at a temperature of 180C. Insulation of Type 2 heaters is applied as a liquid with layers of glass cloth acting as a bonding agent, the curing temperatures being between 80 and 100C.

Under icing conditions, the Britannia elevator horn balances are heated continuously by Type 1 heaters operating from 112-volt DC system, each heating an area of 3.56 sq. ft. and having a power-loading of 3.08 kw. The heating intensity is graded in six steps from a maximum of 15 watts/sq. in. at the nose to 4 watts/sq. in. at the root.

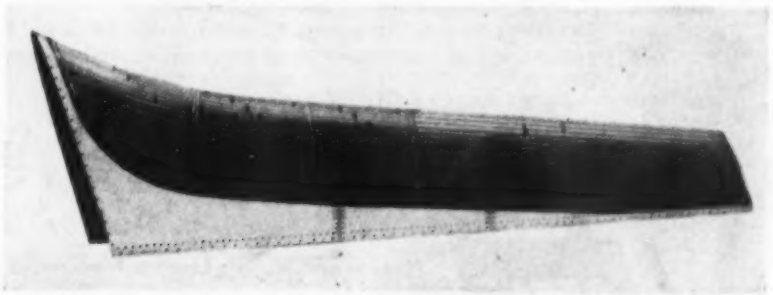
For the leading edges of the fin and tailplane, Type 2 heaters with cyclic de-icing are used.

Each tailplane heater has an effective area of 53.8 sq. ft. and contains 15 independent heater circuits. The fin heater contains 11 circuits and covers an area of 32.6 sq. ft. All the circuits operate from the 208-volt a.c. 3-phase supply at a voltage to neutral of 107 volts. The maximum power loading is 20.5 kw., the heating intensity being graded in each case from 13 watts/sq. in. to 7 watts/sq. in. over the surface of the heater.

Layout of the tail unit heaters provides for the heating of selected areas in a given order and makes provision for proportionate load-shedding in a given order in event of an alternator failure. Heaters are divided into 16 cyclically-heated areas, four on the fin and six on each tailplane, each area being subdivided into a primary and a secondary zone.

Continuously heated breaker strips on the extreme leading-edges prevent the formation of ice caps which might be held in place by air loads, and similar chordwise parting strips ensure clean shedding from each de-iced area.

Two cyclic switches are used to control the primary and secondary areas. In normal operation, the current is



FIN LEADING EDGE before application of outer insulation, showing element paths, busbars.

QANTAS leaps ahead with LINK 707 jet simulator

Qantas, Australia's overseas airline, has selected Link to build the simulator for its Boeing 707 transports.

Thanks to Link experience and craftsmanship, Qantas 707 crews will log thousands of "flight miles" in the simulator without ever leaving the ground.

Link simulators will provide today's rehearsals for tomorrow's reality in the air. Throughout the world, airline travel will be made safer and more reliable through training in Link equipment.

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switched to each primary area to detach ice that has formed by water droplets freezing on impact.

On changing over to the second cyclic switch, the primary and secondary zones of each area are heated in turn, thus detaching any ice that may have formed as a result of water running back from the heated primary zones and freezing.

Cyclic de-icing of large areas of airfoil surface greatly reduces the amount of power required compared with continuous heating. If all 41 circuits in the Britannia tail unit heaters were operated simultaneously the total power required would be more than 220 kw.

Germany Trains New Air Force

Iron Cross of the new West German Air Force marks American built T-33s at a jet training base in Germany. Germans are buying foreign military planes for force.

WHAT'S NEW

Publications Received:

• **1956 Aircraft Year Book**—Official Publication of the Aircraft Industries Assoc., Inc.—Edited and Published by Lincoln Press, Inc., 1143 National Press Bldg., Washington 4, D. C. $6.00; 484pp.

Complete review of the events and developments in military and civil aviation in the United States.

• **Instrument Flying**—by P. V. H. Weems and Charles A. Zweng—Pub. jointly by Weems System of Navigation, Annapolis, Md., and Pan American Navigation Service, North Hollywood, Calif. $6.00; 208pp.

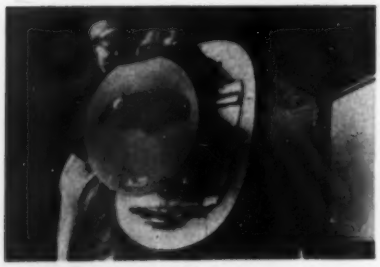
New and revised sixth edition of a guide to instrument flying for pilots and students.

• **Famous Fighters of the Second World War**—by William Green—Illustrated by G. W. Heumann—Pub. by Doubleday & Company, Inc., Hanover House, 575 Madison Ave., New York 22, N. Y.

Detailed histories of the most famous World War II fighter aircraft as used by the air forces of Britain, the United States, Germany and Japan. (Publication date: April 4, 1957.)

• **Management for Growth**—Edited by Gayton E. Germane, Associate Professor of Transportation and Director, Transportation Management Program—Pub. by Graduate School of Business,

The facilities of Executive Aircraft are completely modern and the craftsmen are of the highest skill. Whatever is required, the job done by these craftsmen means your ship will perform more efficiently—with greater safety and comfort.



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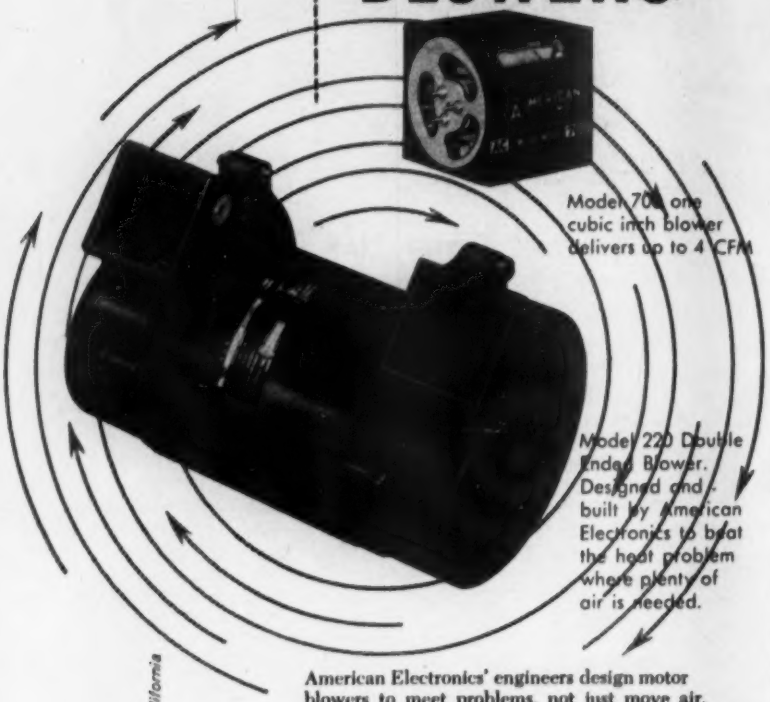
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Ranging from 4 CFM to 250 CFM, American Electronics manufactures a complete line of DC and AC centrifugal blower and fan motor units for a wide variety of functions and applications. AC motor units are available in single or 3 phase at 115 v, 400 cycles. DC units from 12 to 230 volts. All meet pertinent Military Specifications.

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Stanford University, Stanford, Calif. 126pp.

Book is first of a projected annual series, based on presentations made by guest speakers at the annual Stanford Transportation Management Program.

• **Post-War International Civil** Aviation Policy and the Law of the Air—by H. A. Wassenbergh—Pub. by Martinus Nijhoff, The Hague, Netherlands. 180pp.

Discusses problems that arise in the field of force between politics and law in connection with the regulation of civil aviation throughout the world.

• **Wing Leader**—by Group Captain J. E. Johnson, D.S.O., D.F.C.—Pub. by Ballantine Books, 101 Fifth Ave., New York 3, N. Y. Paperbound: 50¢; 292pp.

Group Captain Johnson's account of nearly five years of fighting in the air—from the Battle of Britain to victory in Germany.

• **The World's Fighting Planes**—by William Green & Gerald Pollinger—Pub. by Doubleday & Company, 575 Madison Ave., New York 22, N. Y. $3.50; 240pp.

Completely revised edition of this manual contains specifications, history, performance, and armament data of every military plane in flight and in active use today, regardless of age.

• **Airpower**—The Decisive Force in Korea—Edited by James T. Stewart, Colonel, USAF—Pub. by D. Van Nostrand Co., Inc., 120 Alexander St., Princeton, N. J. $6.50; 310pp.

After an overall discussion of the air war by General O. P. Weyland, this book analyzes specific techniques in three areas: the fight for control of the skies; applied airpower against the enemy on the ground; support elements which made possible the air operations.

• **Physics in Meteorology**—by A. C. Best—Pub. by Pitman Publishing Corp., 2 West 45th St., New York 36, N. Y. $3.75; 159pp.

Purpose of this book is to show that meteorology is one branch of physics, the author demonstrates this by describing and explaining a selection of meteorological phenomena in terms familiar to the student of physics.

• **The Aeroplane Directory,** 1957 edition—Compiled by the Staff of The Aeroplane—Pub. by Temple Press Ltd., Bowling Green Lane, London, E.C.1. 21/-net, approx. $3.00; 603 pp.

Complete guide to aviation throughout the British Commonwealth, its air forces, ministries, organizations, airlines, industries, flying clubs and aerodromes, along with a biographical section containing over 1,550 entries.

Douglas Division Expects Record Year

Douglas Aircraft Co.'s El Segundo Division is scheduled to deliver a new peacetime high of more than 600 airplanes during 1957, according to Arthur E. Raymond, Douglas vice president-engineering. This adds up to one of the division's biggest tasks and most productive years, and one of the biggest dollar volumes in its history, Raymond said in a talk at the 25th anniversary meeting of the Douglas El Segundo Management Club.

Raymond did not identify the aircraft but these will include A3D Skywarriors, A4D Skyhawks, F4D Skyrays, and F5D Skylancers (two more will be built this year in addition to the two previously built. Raymond revealed that the Sparrow II missile was designed for specific use on the F5D by Douglas' Santa Monica Missiles Engineering Dept.

Boar project was identified by Raymond as an El Segundo activity. There was no further elaboration on this project but apparently it was in reference to an atomic-warhead missile in both the air-to-air and air-to surface categories which had been developed by Douglas for Navy Bureau of Ordnance.

Missiles and Weapons Section had been established at Douglas El Segundo on March 1, Raymond said, encompassing armament, fire control, missile compatibility and missile design functions. The section, he revealed, has immediate responsibility for determining the compatibility of all existing missiles to Douglas El Segundo aircraft, to establish missile requirements to future aircraft designs, and to take on any new missile developments or production.

Douglas is now negotiating for construction of a high Mach number 6x6 ft. wind tunnel to be erected at a cost of $8.8 million on a 10 acre site to the south of the El Segundo main plant.

Raymond declared that El Segundo was involved in the design of a new attack airplane in competition with other airplane manufacturers. If Douglas wins this competition, the plane would be given the designation A5D.

"The Navy seems destined to take over part of the job previously handled by the Air Force," Raymond said. "I am referring to some of the tactical missions, the brush fire type of operation in a circumscribed area with limited objectives. With the Air Force placing emphasis on the concept of massive retaliation, there would appear to be an increasing field open to the Navy. Aircraft carriers with attack bombers aboard can have a powerful persuasive effect in certain areas of the world if it becomes necessary for us to flex our muscles a bit. . . ."

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NEW "NO-MAG"

Eliminates Instrument Interference!

• Just as we expected, many aircraft designers were interested in the recent announcement of our new non-magnetic aircraft cable. If you did not see it, "NO-MAG" has these characteristics:

NON-MAGNETIC PROPERTIES . . . "NO-MAG" cable is made from type 305 stainless steel. It remains non-magnetic after severe cold working —in contrast to standard stainless steel aircraft cable which shows a pronounced increase in magnetism after swaging, wire drawing or similar operations.

This non-magnetic property of "NO-MAG" cable eliminates instrument interference from cable magnetism.

CORROSION RESISTANCE . . . New "NO-MAG" cables have corrosion-resistant qualities similar to, but slightly better than, cables made of standard stainless steel.

GOOD THERMAL CHARACTERISTICS... The thermal expansion characteristics of new "NO-MAG" cable are much closer than those of standard stainless steel or carbon steel cables to the characteristics of aluminum alloys used in aircraft. This greatly simplifies maintaining cable tension under various changes in temperature.

HIGH FATIGUE RESISTANCE . . . Preformed construction and careful processing give new "NO-MAG" cable high fatigue resistance.

HIGH ABRASION RESISTANCE . . . New "NO-MAG" cable shows greater abrasion resistance than standard stainless steel aircraft cables.

TENSILE STRENGTH, while lower than that of stainless and carbon steel, is sufficient to enable replacing these, size for size, with "NO-MAG" on many applications where the characteristics of "NO-MAG" are required.

USE WITH SWAGED TERMINALS . . . Swaged terminals can be applied to standard AN dimensions.

COMPLETE RANGE OF SIZES, CONSTRUCTIONS . . . New "NO-MAG" is furnished in sizes from 1/16" to 1" in all of the standard aircraft cable constructions.

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Raytheon has pioneered in the development of electronic missile guidance systems for more than a decade. A technical milestone was reached when the Navy's experimental Lark, equipped with a Raytheon guidance system, achieved history's first destruction of an aircraft by a guided missile.

Today Raytheon, alone among electronics companies, is prime contractor for two missiles of advanced design: the air-to-air Sparrow III for the Navy, the ground-to-air Hawk for the Army. Here, once again, Raytheon's "Excellence in Electronics" is contributing to the security of the nation.

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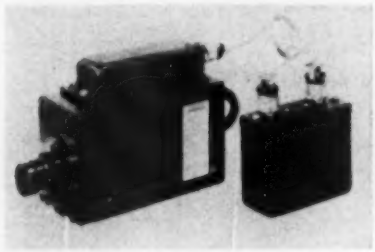


Versatile Record Cameras

TN-9 modification of Bell & Howell N-9 camera is designed for versatile range of instrumentation recording work. Three basic designs are available: TN-9 standard, TN-9A automatic exposure control model and TN-9B pulse-operated interval version.

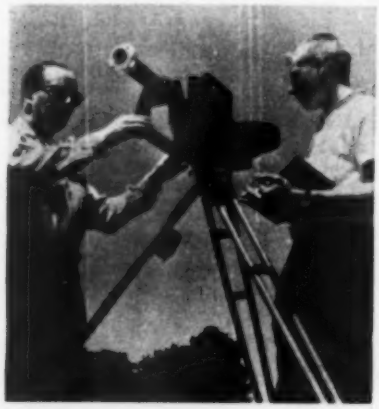
Features include strip or streak operation, conversion to slow speeds of 12, 24, 48 fps. to single high speed of 100 fps.; conversion for operating under 100G loads and use in scope recording.

Traid Corp., 17136 Ventura Blvd., Encino, Calif.

Camera Revolves 360 Deg.

Designed to permit accurate measurement of azimuth angles in spite of differential shrinkage of film or prints, 360-deg. horizon camera turns through complete arc in about minute, driven by 24-v. battery.

Unit was initially used at Distant



Early Warning line to predict radar or micro-wave patterns at station areas, can also be used for plane table work or similar applications. Film capacity is about 400 ft.

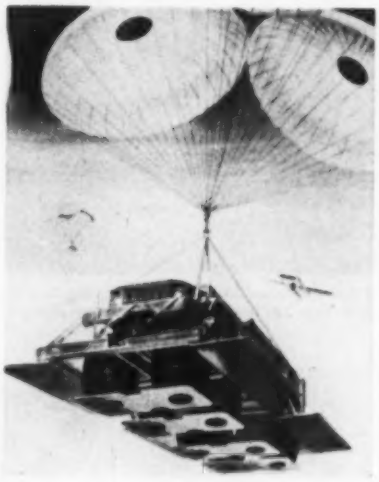
Aero Service Corp., Philadelphia, Pa.

Airborne Electronic Relay

High-temperature airborne electronic relay 204W1 features active getter to absorb residual gas and organic vapors, providing improved operation over ambients of −65C to +125C and under low-current and low-voltage in addition to full loads.

Palladium contacts are utilized on the six-pole double-throw miniaturized and hermetically sealed unit, made to meet MIL-R-5757. One-piece extruded can with two integral mounting flanges guards against high-frequency vibration, shock and salt spray. Unit measures 1.75-in. high, is 1⅛-in. diameter and weighs under three ounces.

Radio Corporation of America, Components Division, Camden, N. J.



Aerial Drop Platform

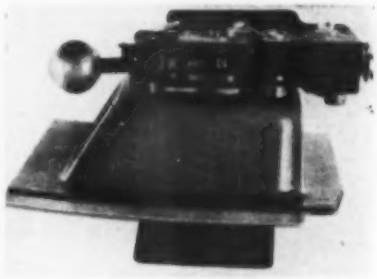
Air bag shock absorbers are featured in aerial drop platforms which range in size from smallest unit capable of accommodating 5,000 lb. loads to largest type capable of handling 20,000 lb. Platforms, produced under Wright Air Development Center contract, are constructed of magnesium with air bags supplied by Aviation Products Division of Goodyear Tire & Rubber Co. Diaphragms control escape of air to prevent blowouts and sudden landing shocks, variable diameter orifice provides controlled deceleration.

Brooks & Perkins, Inc., Detroit, Mich.

Emergency Scoop for Fumes

Ram emergency air scoop was designed to disperse rapidly unanticipated quantities of smoke, oil-mist and the like entering cockpit where regular ventilation system failed to handle material quickly enough.

Fuselage contoured, device can be opened or closed to any of six settings using a hand lever, allowing openings



into the slipstream from one-eighth to three-quarters of an inch. When pilot opens the scoop, integral miniature switches control cabin pressurization and air conditioning system, cabin pressure dump valve. Ram air passes through two spring-loaded check valves provided to prevent reverse flow through the unit when scoop is closed.

Pilots of several major aircraft manufacturers have started to use the scoop for short, low-altitude flights.

William R. Whittaker Co., Ltd., 915 North Citrus Ave., Los Angeles 38, Calif.

Optical Tooling Unit

Telescopic alignment kit for use with General Precision Laboratory's standard PD-150 closed-circuit television system provides precise visual communication in optical tooling setups.

TV camera allows one man to align fuselage or wing frames, with the unit taking the place of an observer behind

a telescope; cross-hairs in each frame are lined up with a light-source cross-hair by watching the pictures on a monitor screen. Additional cameras and alignment kits can be used when the application requires more than one set of cross hairs to establish definite plane; the aligner can refer to any one of the cameras by pushing a selector button.

General Precision Laboratory, Inc., Pleasantville, N. Y.

Long Life Fire Detector

Visual fire detection system, with detector portion designed to last the life of the plane, signals alarm in less than 15 min. after start of blaze, the manufacturer reports. Sensitivity is established to detect a five-inch pan of burning

The Kaman HOK-1 helicopter is famed for its versatility and adaptability to a variety of uses. Based on an actual incident, the photos below show how the HOK-1 can be used effectively as a piece of fire fighting equipment and local crash rescue vehicle.

1. Simulated crash consists of a scrapped plane soaked with aviation gas and jet fuel.

2. Carrying a pilot and three fire fighters, the HOK hovers over fire fighting equipment while ground crewman hooks it to the ship.

3. Flying to the crash scene, the HOK hovers and sets the fire apparatus on the ground automatically.

4. The helicopter lands near the equipment and discharges firemen who begin immediately to unreel the hoses.

5. Hovering over the flames, the HOK uses the powerful downwash of air from its rotors to beat down the fire. Firemen go into action.

6. Mission is accomplished as chemicals open path for the rescue of the "pilot." Elapsed time from arrival on the scene — 45 seconds!

Kaman's continuous research is helping to keep our National Defense effort strong.

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SPECIAL
Structural Engineer to be responsible for design of airframe components. Minimum 3 years experience. Creative ability essential. Opportunity for professional growth and advancement. Reply confidential to W. M. Tynan, Administrative Engineer.

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Send me solution to your rebus and information on Kaman.
My engineering position is _____

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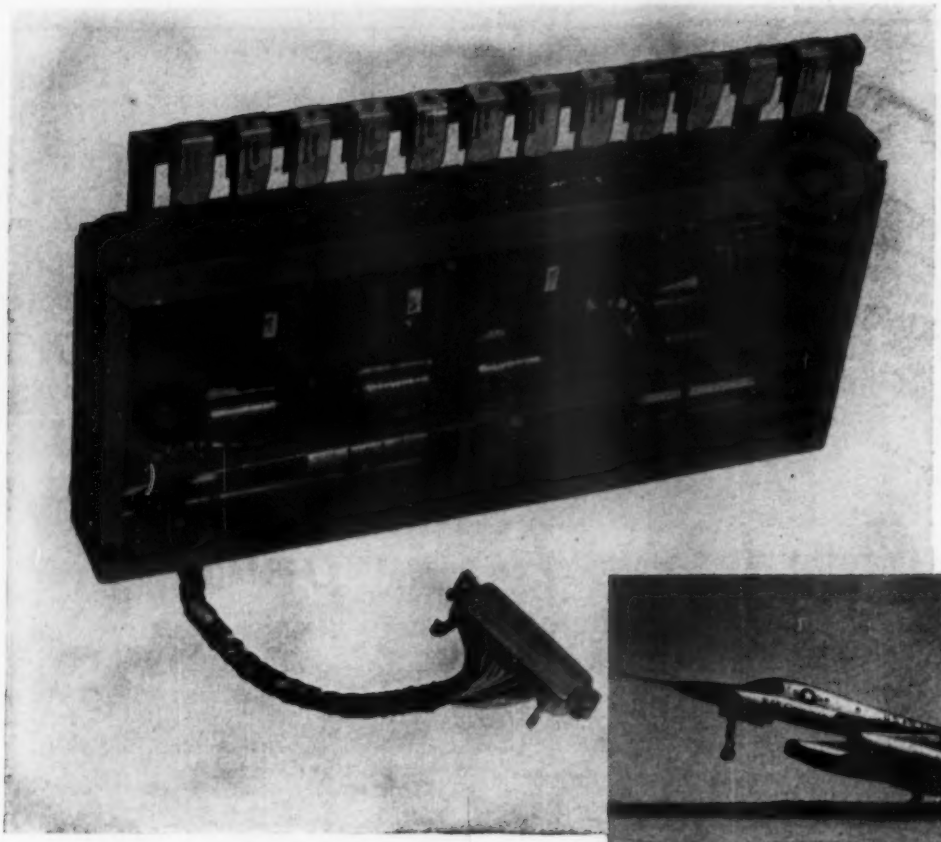

Silastic parts are used in many of the fire control electronic "packages" on Convair's new B-58 Hustler because they remain resilient at both high and low temperatures. Some of the parts touch miniature tubes that operate at 350 F. Others are subjected to oven-hot "cooling" air. All must withstand severe vibration at temperatures as low as —65 F when the equipment is not in use during high altitude flight. Designer and producer . . . Emerson Electric Manufacturing Company, St. Louis.

SILASTIC protects electronic packages on B-58

SILASTIC,* Dow Corning's silicone rubber, can be used in many different ways to improve the protection and performance of delicate electrical and electronic equipment. Whether used in the form of seals, cable clamps, grommets, encapsulating or potting compounds, plugs, gaskets, feed throughs, or wire and cable insulation, SILASTIC offers amazing thermal stability, excellent dielectric strength and superior resistance to moisture, ozone, corona, corrosive atmospheres. Write for complete data or contact your rubber supplier.

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* T.M. REG. U.S. PAT. OFF.

Typical Properties of Silastic for Electrical Use

• Temperature range, °F	—130 to 500
• Tensile strength, psi	600 to 900
• Elongation, %	150 to 300
• Insulation Resistance, megohms/1000 ft.	1000 to 3000
• Dielectric strength, volts/mil.	300 to 500
• Dielectric Constant, 10^2 cycles per second, nominal	3.2

If you consider ALL the properties of a silicone rubber, you'll specify SILASTIC.

first in silicones — DOW CORNING SILICONES

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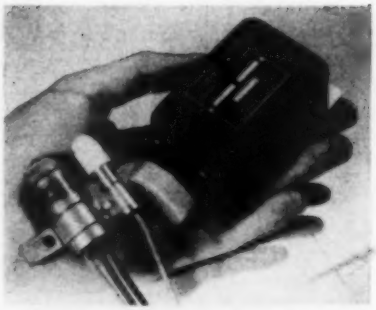


fuel at five-foot distance, the system provides complete discrimination against sunlight and all forms of interior lighting.

System weight is one pound, including control unit and six detectors. Standby current is 100 m.a. at 28 v.d.c. and the system will operate between 18 and 34 v.d.c. Estimated continuous operating life is 10,000 hr., ambient temperature range is −65 to 300F; later versions designed to handle higher temperatures are under development.

Pyrotector, 349 Lincoln St., Hingham, Mass.

Oxygen Trigger Valve

Automatic oxygen trigger valve works at predetermined altitude setting so that if cabin decompression occurs, the airplane's oxygen system is activated. Valve is a component of company's automatic "drop-out" oxygen system;

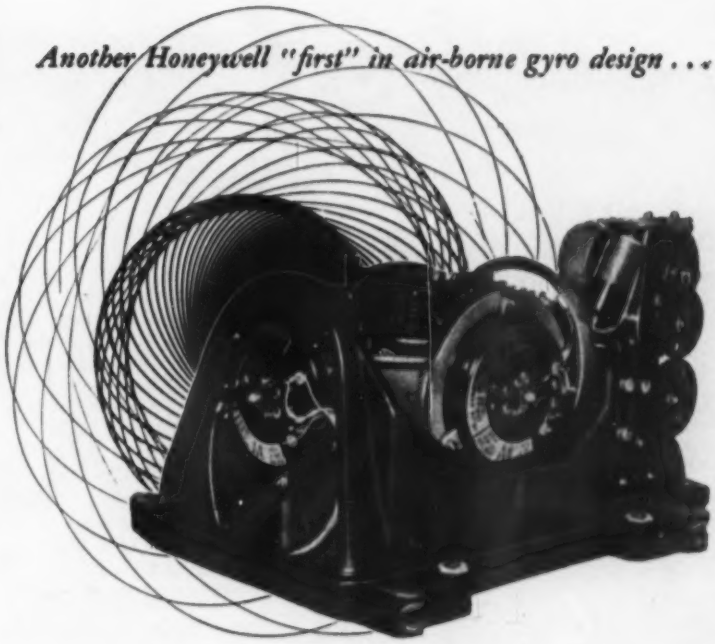
compartment doors open instantly when pressure drops, with oxygen masks falling in front of each passenger. Flow to mask begins when passenger pulls mask toward face.

Scott Aviation Corp., Lancaster, N. Y.

Arming Solenoid Goes High

Arming solenoid that operates unpressurized to high altitudes has been fully qualified to 80,000 ft. and successfully tested at 115,000 ft. Weighing 11 oz., its normal power drain is 0.7 amp. and it operates down to 18 v. At

Another Honeywell "first" in air-borne gyro design . . .



Honeywell's new synchro cageable vertical gyro preserves test-stand accuracy

Power Requirements:
Gyro motor: 115 volts, 400 cps ±10%, three-phase.
Erection motors: 26, 30 or 115 volts, 400 cps, single-phase.
Synchro and Resolver: 26 volts, 400 cps. Output of 11.8 ±0.6 volts line to line.
Caging circuit: 28 volts dc.

Power Load:
Gyro motor: 50 watts starting; 20 watts running.
Erection motors: 5.5 watts each at 26 volts; 6.5 watts each at 30 volts; 4.5 watts each at 115 volts.
Caging circuit: 42 watts operating; 6 watts holding.

Gyro Speed: 21,000 rpm min.

Angular Momentum: 6.33 x 10^6 gm-cm^2/ sec.

Inner Axis: Limited at ±85° by precession pins.

Outer Axis: Unlimited.

Caging Time: 10 seconds max.

Gyro Run-down Time: 5 minutes minimum.

Erection Rate: 2° to 8° per minute (factory adjustable).

Scorsby Drift Rate: Does not exceed 0.4° per minute without erection.

Accuracy: 0.15° of true vertical about each axis, or better.

Synchro Accuracy: ±6 minutes.

Weight: 7 lb.

Modifications:
Yaw, roll, directional available to your specifications.

HONEYWELL's new GG53A cageable vertical gyro is the world's first to have synchros and resolvers guaranteed to give test-stand accuracy.

This is made possible by an exclusive mounting on the gyro that permits exact duplication of synchro accuracies after assembly to the gyro. In addition, "V" groove feet permit easier, more accurate installation of the GG53A.

Primarily designed for vertical reference in flight control, radar stabilization systems and telemetering, this lightweight synchro gyro is also highly recommended for any system requiring angular position reference.

Two types of caging mechanisms are available for the GG53A, depending upon requirements. One has a power-on uncage and a power-off caging operation. The other has a power-on operation for both caging and uncaging.

The specifications on the new Honeywell GG53A are detailed at left. For further information on the full line of Honeywell Gyros, write: Honeywell Aero Division, Dept. AW-3-80, Station 661, 2600 Ridgway Road, Minneapolis 13, Minnesota.

MINNEAPOLIS **Honeywell**

Aeronautical Division

LOST? It can happen to the best of PA's and other seat-buying airline execs! Seats, like other custom-built products, could easily get a guy "lost in the woods" over involved specs, costs, weights, production schedules, design evaluations and other details not usually a problem in buying routine replacement items.

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CONTROL ENGINEERING UNIT
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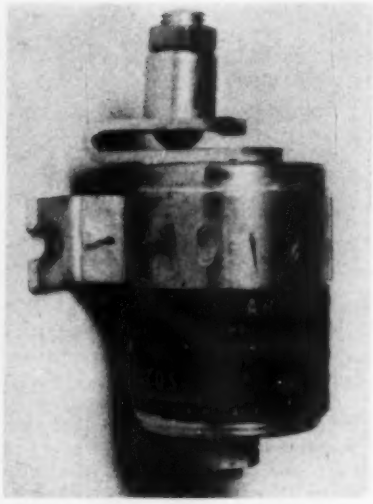
For information and help on heat protection problems write: P.O. Box 2067, Santa Ana, Calif.

Eastern Manufacturing Facility: Watertown, Conn.

JOHN J. FOSTER MFG. CO.



−65 deg. and 29 v.d.c., power drain is I amp. Operating temperature is −65 to +250 deg.

Fairchild Engine & Airplane Co., Western Branch, Stratos Division, Manhattan Beach, Calif.

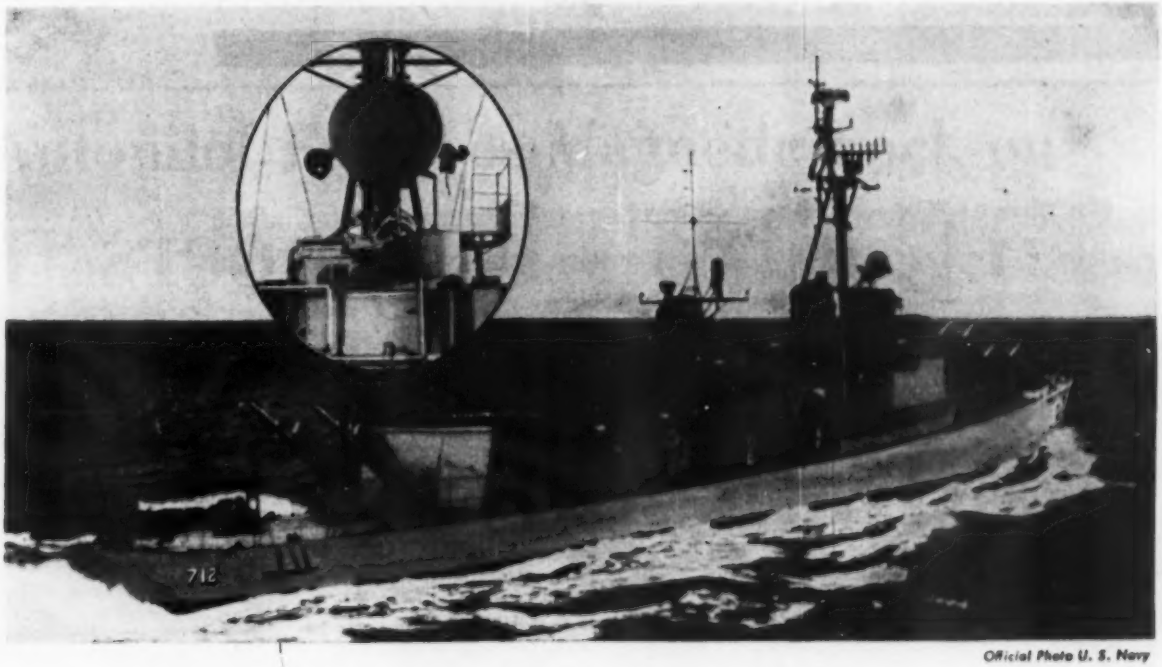
Hydraulic Pump for 5,000 Psi.

Successful operation of an advanced version of Model 66W Stratopower aircraft hydraulic pump for over 1,000 hr. of cycling endurance at 5,000 psi. is reported for new design. Latest equipment delivers approximately 7.5 gpm. at 3,750 rpm. and is within one-quarter pound in weight of a standard pump

rated for this flow at 3,000 psi., the manufacturer states.

Tests of the new pump included: Mil-0-5606 oil at 160F and inlet pressure sea level. Cycling was once per minute from full-flow pressure of 4,500 psi. to non-flow at 5,000 psi. Applications would include normal operating ranges of 3,000-3,750 rpm.

Watertown Division, New York Air Brake, Watertown, N. Y.



Official Photo U. S. Navy

unique dual-role radar guidance system by Reeves

Developed for U. S. Navy Bureau of Ordnance

Twin Terrier Missile Launchers, shown in this official Navy photo on the after-deck of the USS Gyatt, give the world's first guided missile destroyer an atomic-age weapons system equal in range, accuracy and striking power to that usually associated with a 45,000-ton ship.

Key to this successful installation of the supersonic Terrier system in the close quarters of a destroyer is the unique new Reeves **combined** automatic missile radar guidance and fire control system, developed out of Reeves' experience with previous successful Terrier installation "firsts" in the cruiser USS Boston and in the battleship USS Mississippi.

While serving the dual role of automatic radar tracking and guidance for the Terriers, as well as fire control for the destroyer's 3" and 5" guns, this new Reeves system is compact (as shown by inset photo above), has great range and precision, and is capable of self-monitoring. It requires few operating personnel.

Here is yet another example of Reeves' close and highly successful association with the U.S. Navy and other branches of the Armed Forces in many of the military electronics projects that have been or will be recorded as dramatic "firsts" in their fields. Reeves research, engineering and unique precision manufacturing facilities are specifically geared to this pioneering tempo.

helps Navy's first guided missile destroyer pack a battleship's wallop

RESEARCH and DEVELOPMENT ENGINEERS . . . find a rewarding career in Reeves' expanding program in the fields of guidance, radar, automation, and computers. Positions available now at all levels. Write to Engineering Personnel Dept., Reeves Instrument Corp., Roosevelt Field, Garden City, Long Island, New York.

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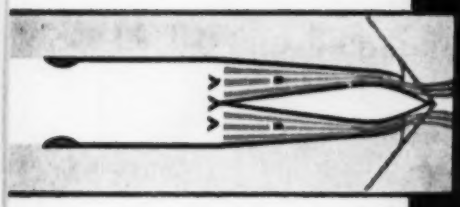
A STATEMENT OF FACT FROM MARQUARDT

To Controls Engineers

Ready for

Advanced Projects



Controls engineers—with a yen for advanced, creative projects—will find challenging employment opportunities at Marquardt Aircraft.

Why? Because, at Marquardt the time differential places the projects—and engineers working on them—years ahead.

For example, take the controls problems that are of vital interest to the aircraft and missile industry—problems that are associated with turbojet engines operating in the Mach 2 range.

Marquardt controls engineers solved many of these problems more than five years ago when the company began flying ramjets at supersonic speeds. Today this ramjet knowledge is being applied to turbojets which are now advancing into higher supersonic speed ranges.

Pneumatic, hydraulic, or electronics controls engineer, ready for advanced creative projects, are invited to explore the opportunities at Marquardt. Contact or send a personal resume to: Jim Dale, Professional Personnel, 16555 Saticoy Street, Van Nuys, California.

marquardt AIRCRAFT CO.

VAN NUYS, CALIFORNIA — OGDEN, UTAH

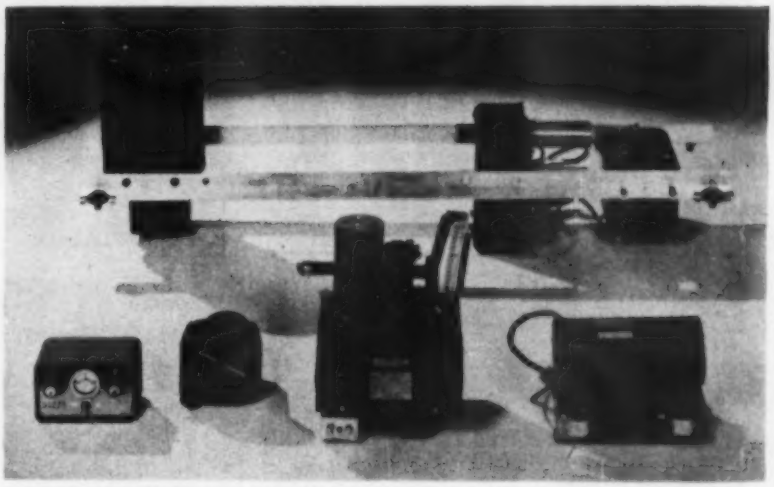
Autopilot Features Magnetic Lock-on

By Erwin J. Bulban

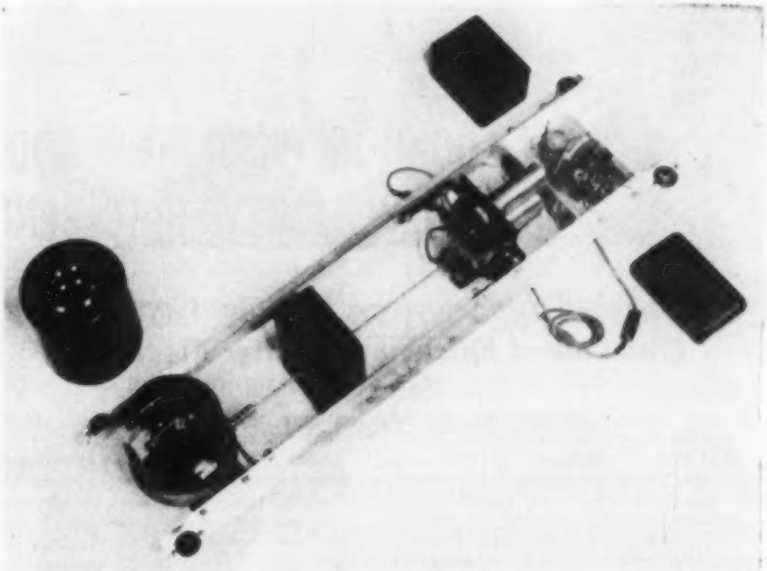
New York—Globe Mk. II single-axis autopilot, featuring magnetic heading course lock-on and anti-spiral stability, will be available to lightplane owners in June for under $1,500 installed.

Unit is the second item in a series of "building blocks" programmed by Globe Industries, Inc., Dayton, Ohio, which eventually will provide a fully automatic flight control system for business pilots. Initial unit in the system was Globe's Gyro/Stabilizer Mk. I, the spiral stability portion. Current owners of this unit can add the new second portion, giving magnetic heading control, at a conversion cost of $725.

Globe Mk. II is currently CAA approved for Cessna 170, 172, 100 and 182; Piper Tri-Pacer series approvals are pending, the manufacturer reports.



MAJOR COMPONENTS of Globe Mk. II, foreground, left to right: command console, remote compass indicator (optional), servo actuator and rate gyro. At top is heading lockmagnetic compass and signal amplifier assembly.



MECHANISM of magnetic heading lock assembly is detailed with cover plates removed, left to right: magnetic compass; heading lock servo having two Globe miniature precision motors, compass feedback system and transmitter for optional compass indicators; error signal amplifier.

Magnetic Compass

Heart of the system is a precision magnetic compass especially stabilized to reduce northerly turning error. Globe chose a magnetic compass over a directional gyro in order to make its Mk. II independent of the operator's existing instrumentation and also to avoid drift characteristics of a directional gyro. Accuracy of the magnetic compass is enhanced by mounting behind the baggage compartment.

Purchasers can also get an instrument panel indicator for remote reading of the magnetic compass as optional equipment; price of this item has not yet been decided.

Command console, measuring four inches wide x 2¼-in. high x 2¼-in. deep clamps onto the airplane's control wheel hub; optional mounting can be on the instrument panel or on the ceiling.

Choice for Pilot

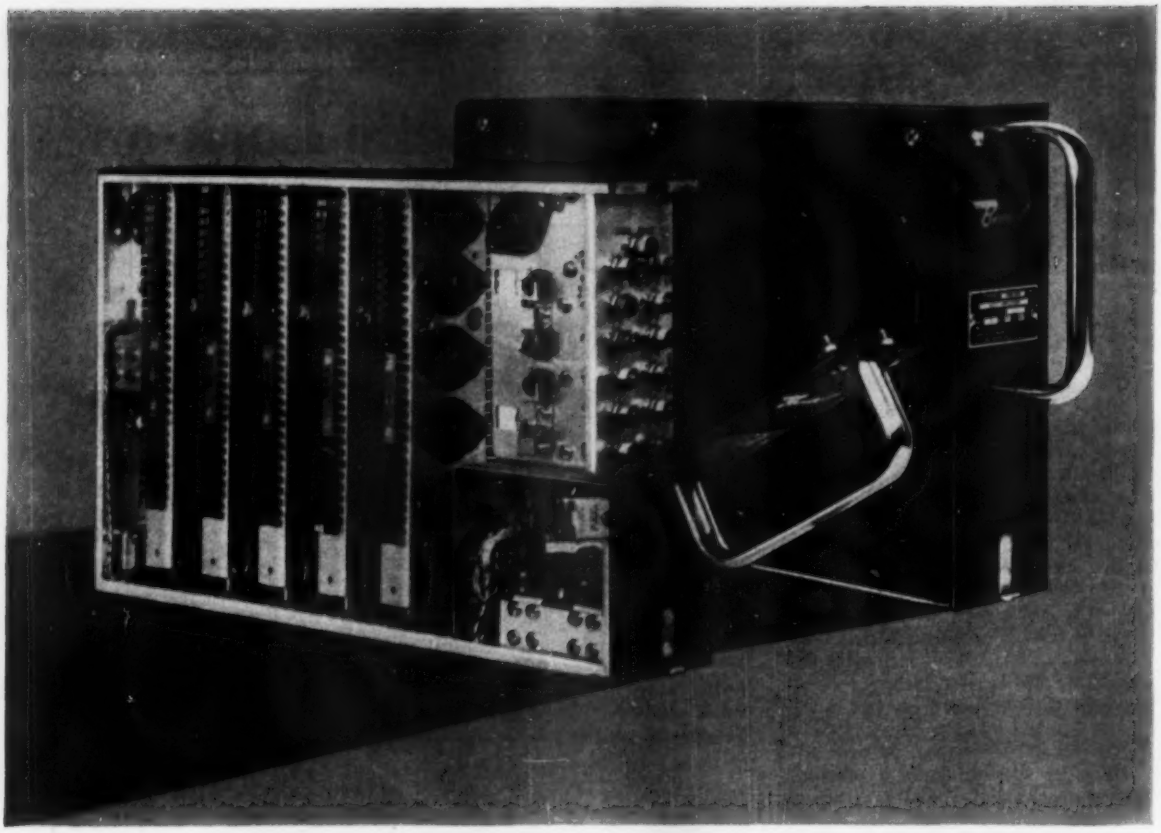
Arrangement of the controls provides the pilot with an option of using the Mk. II as a Gyro/Stabilizer or autopilot with heading sense and memory. To use as a Gyro/Stabilizer, the function switch (on left of console) is turned to "GS" and the push-pull control is operated to engage the unit. Warm-up time for this portion of the system is two seconds. Stabilized turns at a rate of up to three degrees per second are possible by turning the trim-turn knob the right of the console.

The remote compass indicator is activated alone by moving the switch on the left to "STBY", without engaging the unit. After this is done, the system is locked onto a heading with the following procedure:

- **Engage the system** with the push-pull control.
- **Adjust trim-turn knob** for straight flight on the desired heading.
- **After 60-sec. warm-up,** move the heading trim switch, at bottom center, toward the off-centered needle.
- **Turn function knob** to "HL".

When used in conjunction with the Gyro/Stabilizer, function knob is moved to "STBY" after unit engages.

After the magnetic heading is set



A "NEW LOOK" IN PASSENGER ADDRESS AMPLIFIERS —THE NEW LIGHTWEIGHT BENDIX AMA-10A

Completely Transistorized, Modular Construction, Unmatched Efficiency, Greater Flexibility

A new concept in passenger address amplifier design, the lightweight Bendix AMA-10A is brand-new all the way through. Now completely transistorized, its new light weight and modular construction are ideally suited for aircraft where weight, space and power requirements are important considerations. At the same time, the AMA-10A provides a degree of flexibility and efficiency unattainable with other equipment.

Bendix*—whose products and equipment employ more than a million transistors annually—now utilizes its vast experience and practical know-how to produce this new, lightweight, high-reliability amplifier system.

Since tubes are completely eliminated, there are none to jar loose; no need for shock-mounting. Operation, for all practical purposes, is instantaneous. Reliability and over-all efficiency reach an all-time high.

Modular construction permits "customized" audio system installation for any aircraft. The system is completely flexible. Five plug-in module amplifiers produce 10 watts output each—a total of 50 watts. Individual controls are provided for each module to compensate for differences in ambient noise levels within the airplane under all in-flight or on-the-ground conditions. It provides power *only as required*.

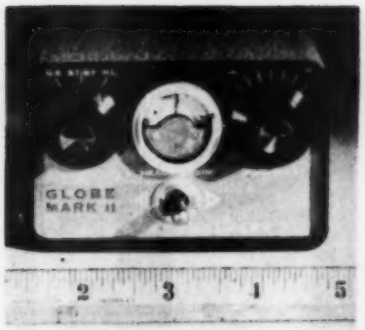
Weight: only 6 pounds. Size: short ½ATR case. For complete specifications write Bendix Radio, Aviation Electronic Products, Baltimore 4, Maryland. Or West Coast—10500 Magnolia Blvd., N. Hollywood, Calif.; export—Bendix International Division, 205 East 42nd Street, New York 17, N.Y.; Canada—Computing Devices of Canada Limited, P.O. Box 508, Ottawa, Ontario.

*TRADE MARK

ENGINEERS: **Because of our vast expansion program, several career opportunities are now available in the design and development of commercial aviation electronic products. We invite your inquiry.**

Bendix Radio Division

Bendix
AVIATION CORPORATION



COMMAND CONSOLE is mounted in cockpit. Function selector switch (left), heading trim togglemeter and toggle switch (center) and trim control for stable turns (right).

into the unit, it is retained until the pilot changes or over-rides it. He changes heading by pushing the heading-trim switch to either the left or right, the airplane changing course at a rate of one degree per second; for three-degree rate of turn, he puts the unit on "STBY" and rotates the trim-turn control in the direction desired.

Heading retention is accomplished by photo-electric pickoffs in the compass, which sense changes, amplify these error signals and feed them to a servo, which in turn induces a signal in the Gyro/Stabilizer system, correcting rudder.

Hunting Clan Orders DC-6As to Use in Africa

London—Two Douglas DC-6A Liftmasters have been ordered by Hunting-Clan Air Transport at a cost of $3.3 million with spares, for delivery in 1958.

The independent airline disclosed at the same time that it has sold to Icelandair the two Viscounts which have been standing idle at London Airport since the government refused permission several months ago for the airline to use them on "colonial coach" service to Africa. Hunting Clan also has sought to buy Central African Airways without success.

The Douglas aircraft will be used primarily on all-freight service between Britain and Africa, replacing York aircraft now used.

Executive Turboprop

Los Angeles—On Mark Engineering Co., Van Nuys, Calif., will soon unveil an adaptation of the Douglas B-26 to a pressurized, turboprop executive transport. Airplane will have almost wholly new cylindrical fuselage, reworked wings. Tail assembly will retain original configuration. Probable powerplant is Allison 501D, with Aeroproducts propeller.

U. S. Group Backs Brazil Lightplane

Rio de Janeiro—Two Brazilian state-owned companies are combining forces to produce a diversified line of light aircraft with financial support from private U. S. business sources. The American group is interested in backing the venture by supplying $1.5 million in equipment, provided the Brazilian firms production plans are approved by their country's air force and its equivalent of the U. S. Civil Aeronautics Board.

A four-place lightplane for air taxi and business plane use, resembling Cessna designs is being readied for production by the companies.

One of the firms, OMAREAL, is now producing a two-place trainer, the Paulistinha. Brazil's air force reportedly has ordered 20 and may purchase additional Paulistinhas. Sociedade Constructora Aeronautica Neiva Ltda., the other manufacturer, is completing prototypes of two and four-place aircraft. The Brazilian air force has ordered two prototypes of a tandem-seat high-wing liaison/observation plane from the company.

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Type 11-4133-01 is a size 11 torque transmitter synchro with 115V 400 cycle input. Accuracy is ±15′, null voltage 175 mv, stator output 90 volts and phase shift 6.5°. Impedances are $Z_{RO}=315+J1590$, $Z_{SO}=290+J773$ and $Z_{RSS}=520+J286$.

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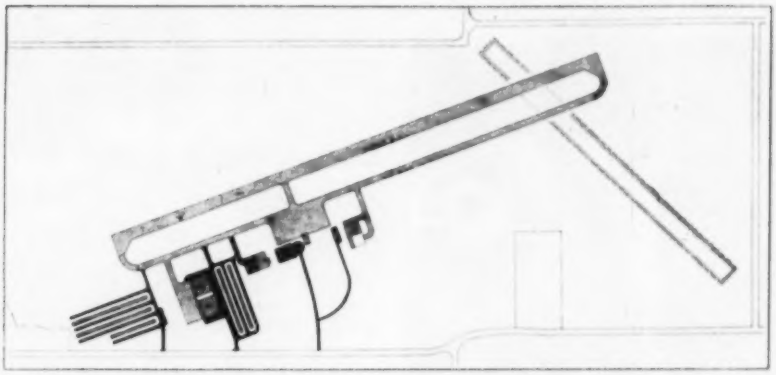
Other products include actuators, servos, AC drive motors, servo mechanism assemblies, DC motors, motor-gear-trains, fast response resolvers, servo torque units, reference and tachometer generators and motor driven blower and fan assemblies.



PRIVATE AIRPORT near Dallas, Tex., will have 4,500 ft. hard surface runway.

Dallas Businessmen Building $2.3 Million Private Airport

Dallas—A new, $2.3 million private airport is under construction near here, designed to handle the increasing volume of executive flying in Dallas area.

The new field is on a 400 acre tract in Addison, about 15 mi. north of downtown Dallas. It will be ready for flight operations about June 1, and all construction will be completed by July 1.

Directors of the airport company include John Murchison, W. T. Overton, Toddie Lee Wynne, Jr., W. D. De Sanders and James I. De Loache. The group is currently selling a $300,000 issue of convertible debentures to cover part of the $1,291,000 cost.

A survey of the Dallas area shows a total of 873 active non-airline aircraft.

A major selling point for the new field in the view of the airport's management is that it is more convenient to north Dallas than Red Bird Airport, the municipal airfield for executive use located in the southwest part of Dallas. A company survey shows that the majority of executive aircraft users live in north Dallas.

Present construction plans include a 4,500-ft. hard surface runway designed to handle aircraft up to a Convair Liner. Within five years, the runway will be extended another 1,000 ft. The airport also will have a system of hard surface taxiways and parking ramps. A 3,200-ft. turf strip will provide a second runway.

The $50,000 terminal building, measuring 45 x 106 ft., will include a ready room, offices, lounges, and a restaurant.

Terminal will have two-way radio communications with the airport's fuel trucks.

A terminal VOR will provide assistance in approaches at Addison, and in a year or so, when aircraft movements reach 2,000 a month, a control tower will be built.

Aircraft servicing will be handled by Dal-Tex Aviation, local Cessna dealer, which will have its own hangar and showroom. Associated Radio Corp. will

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Two or more units may be coupled together. This feature makes it possible to provide as many different and perfectly synchronized pressures as the air frame and air craft components to be tested demand. An easily read scale and pointer indicates the percentage of maximum preset pressures being delivered.

This unit which can be bought or leased, has found ready acceptance in the aircraft and related industries. Write for brochure giving full details of construction together with operating features. Find out how valuable this unit can be in your service.

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MULTIPLE PRESSURE CONTROL UNIT
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MARGINATOR COMPANY
1121 West Magnolia, Burbank, California

Revised Howard Has 150 Mph. TAS

Modified Howard DGA-15P floatplanes have metallized fuselage, extra cargo door and seating capacity increased to six. True airspeed of 150 mph. is claimed by modification firm, Jobmaster Co., Seattle, Wash., using 70% power at 7,000 ft. Package plans for reworking standard airplanes runs from less than $20,000 to over $25,000.

have a similar facility for radio work.

Collins Radio Co. and Delhi-Taylor Oil Company have each contracted for separate hangars for their executive flight operations. Murchison Brothers and Union Chemical and Materials Corp. will also use the Delhi-Taylor facility.

Collins and Delhi-Taylor hangars will be cantilevered structures providing a 120 x 160 ft. open area which will be 30 ft. high. At the rear of each hangar is a 40 x 160-ft. two-story area for shops, storage and office space. Addison Airport also will have 150 T-hangars.

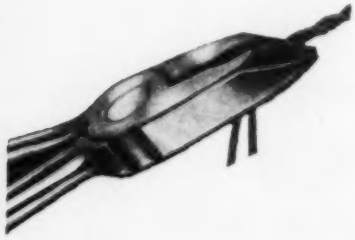
Industrial Exhibits Aid Airplane Sales

Proof that industrial trade shows are a major source of business aircraft sales contacts is provided in Beech Aircraft Corp.'s recent experience with its exhibit at the American Road Builders Assn. show in Chicago.

Three aircraft cabin mockups and a full-size complete Beech Bonanza, plus a styling display, highlighted the company's floor exhibit at the International Amphitheatre. A 35-ft. semi-trailer and a 1½-ton truck moved the major portion of the display, the Bonanza being flown to Chicago, where it was disassembled, taken to the Amphitheatre and reassembled. Ten Beech personnel, including distributor people, manned the display, surrounded by exhibits of light and heavy earth moving and construction equipment.

Their comment: "We feel that our participation was extremely worthwhile." Of the approximately 50,000 people attending the ARBA show, the majority visited the Beech display and its representatives obtained the names

You save two thirds the time...



...when you safety wire with a ROBINSON

ELEANOR AFANASIEF USES A ROBINSON . . .

Seen at McClellan Air Force Base, Eleanor is wiring an R-4360 engine — the type used on the B-36, B-50 and C-124 Globemasters. Her wire twister is a Robinson model M80 with the exclusive diagonal jaw design.

A three way tool — twister, cutter, plier — the $18.50 Robinson product is at home on the production line or in the shop where it adapts to bench work on radio, radar equipment, magnetos, carburetors and instruments.

Fully descriptive literature is available from the manufacturer.

ROBINSON — FIRST NAME IN WIRE TWISTERS

THE ROBINSON WIRE TWISTER

Write to Ralph C. Robinson Company, Dept. W., Box 3494, 2516 Crosby Way, North Sacramento 15, California

Chop weight, get thinner sections with Alcoa high-strength castings

Reduced weight and higher strength are now casting realities. Thinner sections, lighter parts are now possible. Castings can be stressed to new limits. Alcoa's new high-strength process guarantees you high properties.

Formerly, the properties of a casting were based on separately cast test bars. In design and application, a casting factor had to be applied to reduce these properties. With Alcoa's new high-strength casting method, properties are based on bars cut right from the casting itself. No reducing necessary. And, best of all, the guaranteed properties are in *all* the castings in the run . . . consistent, guaranteed, high properties in castings for aircraft structural parts.

New carefully controlled foundry practice and improved alloys are the developments responsible. The alloys are A356 and C355. These are the same composition and meet specifications for familiar alloys 356 and 355, with one difference: Impurities are controlled to a new minimum. Iron content, for example, is held to 0.2% in the improved alloys. Such seemingly minor changes make a whale of a difference.

Equally careful control in all steps of the foundry process, plus several new Alcoa developments in aluminum foundry techniques, is also vital in making these high-strength castings.

High-strength castings can be made in sand or plaster molds . . . sometimes in permanent molds. Alcoa's standard guarantee of properties for alloy A356-T61 is 38,000 psi tensile, 28,000 psi yield, and 5% elongation. Occasionally, because of complex shapes and designs, high strength can be furnished only in certain areas of the casting. But, by working closely with the designer, Alcoa can usually put the high strength right where it's needed.

Your Alcoa sales engineer has the facts on this new process. Let him work with you in obtaining castings with high properties—properties that don't have to be reduced in application. Aluminum Company of America, 1800-D Alcoa Building, Pittsburgh 19, Pennsylvania.

Important missile structural castings for Douglas. Alcoa's high-strength casting process and alloy A356-T61 give them some of the highest properties ever cast. Here are the properties obtained on test bars cut from the castings.

	Tensile, ksi	*Yield, ksi*	*Elongation, %*
Front Casting			
Average	43.2	32.1	9.7
Maximum	44.4	34.1	11.0
Minimum	40.5	30.3	6.7
Tests—8 from 8 production runs			
Back Casting			
Average	45.1	34.3	5.5
Maximum	47.1	36.9	9.0
Minimum	40.2	32.2	4.0
Tests—22 from 12 production runs			
Minimum Required	**40.0**	**30.0**	**3.0**

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ALCOA ALUMINUM
CASTINGS

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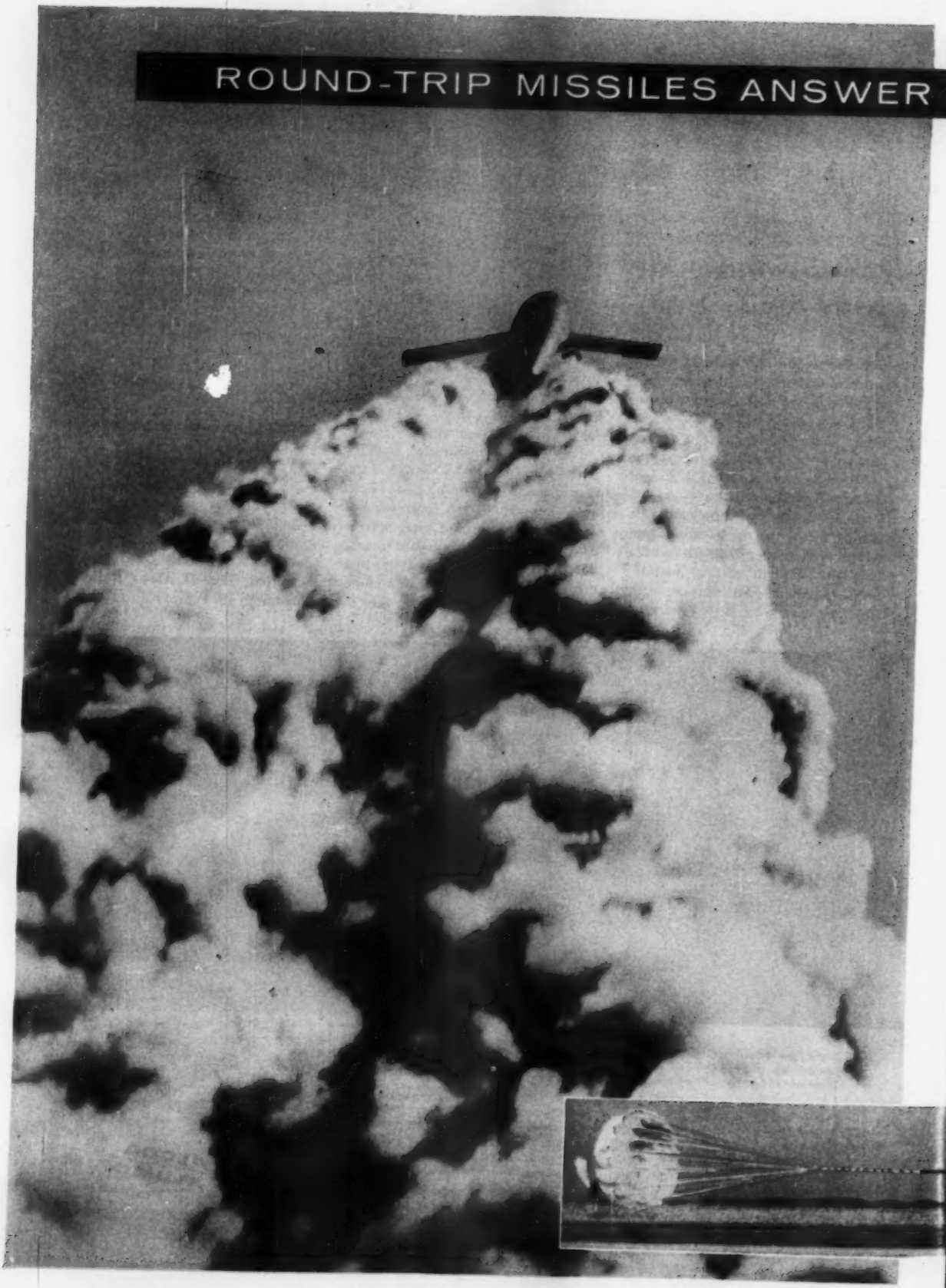
ROUND-TRIP MISSILES ANSWER



ENGINEERS' QUESTIONS AT VOUGHT

"Old Indestructible" Paid a $3 Million Dividend in Data

When a missile can be flown . . . recovered . . . and flown again, it becomes an acquaintance. When a single Regulus I missile came home 15 times, it got a name.

"Old Indestructible" began her career by returning flight test information to Vought engineers. The missile gave the acid test to new launching methods, guidance principles, performance maximums and telemetering channels. Three flights, and the bird had paid for herself in fat data installments.

When the missile had been picked clean by Vought reliability and systems men, she joined the Navy. Fleet submariners and surface seamen were ready to operate Regulus as a target drone and nuclear weapon. Old Indestructible was chosen to teach them.

The missile qualified six Navy teams in Regulus tactics, logistics and maintenance. Repeated launchings at 70,000 pounds thrust stretched her airframe. Flight and ground-run time on some components mounted above 1,000 hours. Operationally, however, the missile was sound when time came for her 16th and final flight, a shipboard launching in a simulated nuclear attack.

Thanks to Old Indestructible's dogged returnability, Vought engineers could design its reliability standards into every Navy-bound Regulus. Results were unprecedented. With the Fleet, Regulus I has completed its 500th successful flight with outstanding on-target success probability.

Today, Vought missile men are using the recovery concept to foolproof a mightier missile. Their Regulus II has completed 13 flights to date. Significantly, six of these flights were made by one missile.

Package Designer for Electronic Equipment. Mechanical or Electrical Engineer to design the package and structure of stabilization systems, antennas and other high reliability electronic equipment. Requires engineering degree or equivalent. Related experience desirable.

Guidance Engineer. Develop and design radar, magnetic, inertial, infrared, animal and other guidance and recognition systems beyond present state of art. Requires ingenuity and analytical ability, with degree and experience in development engineering or physics.

4 IMMEDIATE OPENINGS FOR ENGINEERS

Propulsion Engineer. Graduate M. E. or A. E. with up to 3 years technical experience in related fields for analytical work in Propulsion. Opportunity to learn following systems: advanced power plants, heat transfer, thermodynamics, fluid dynamics (compressible and incompressible). Determination of installed performance of engines, fuel systems, air conditioners, APU's, etc., provides opportunity for technical coordination and liaison with engine and equipment manufacturers.

Senior Propulsion Engineer. Requires degree plus minimum of 4 years experience with supersonic inlets and internal compressible flow. Up-to-date knowledge of induction and exhaust field, mature judgment and know-how required. Willing to learn installed power plant performance analysis and interested in progressing into analysis of other propulsion systems.

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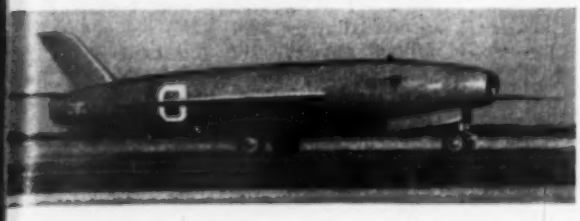
To arrange for a personal interview, or for a prompt report on these or **other current openings,** return coupon to:



Mr. C. A. Besio A-7
Supervisor Engineering Personnel
Chance Vought Aircraft
Dallas, Texas

I am interested in a detailed report ( ) personal interview ( )

on opening for _____

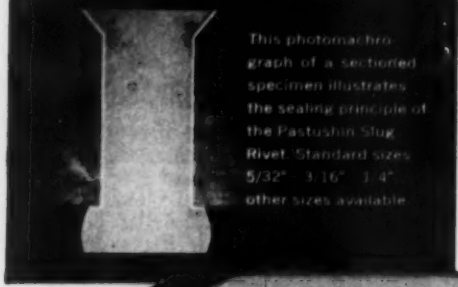
Name _____

Address _____

City and State _____

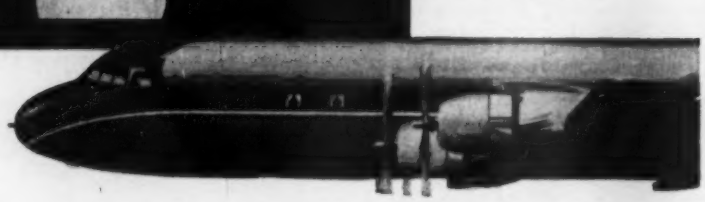
Pastushin

FLUID-TIGHT JACKETED RIVETS



This photomachrograph of a sectioned specimen illustrates the sealing principle of the Pastushin Slug Rivet. Standard sizes 5/32" 3/16" 1/4" other sizes available

...flight tested millions of miles



Flight tested by millions of rugged air miles flown by the finest commercial and military aircraft. Pastushin Fluid-Tight Rivets automatically seal themselves when they are driven, without the use of conventional sealants.

Sealing is accomplished by the use of a soft aluminum sleeve which extrudes into any wall cavity as the rivet is being driven.

Pastushin Rivets are available for immediate delivery—Here is just a partial list of users:

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CANADIAN PACIFIC AIRLINES, LTD.
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SCANDINAVIAN AIRLINES SYSTEM
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Pastushin Fluid-Tight Jacketed Rivets are available for use with automatic machines and for installation where hand-driven equipment is required. Both types give absolute Fluid-Tight construction. The Pastushin Repair Kit is available for field applications. Ask for Bulletin PA-3, which gives full instructions for its use.

Write for Slug Rivet catalog PI-5 and No. PA-3 for details on the Pastushin Repair Kit.

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of several hundred good prospects, and actually talked to several thousand visitors.

Since the construction and petroleum industries are two major business plane markets, Beech plans further participation in their major shows. It was the first time the company had set up a display at a roadbuilder's show; it had previously been represented at the International Petroleum Exposition at Tulsa, Okla, held every four years. A Beech spokesman states that in all probability the company will cover both shows in the future.

PRIVATE LINES

Colonial Skimmer amphibian number 18 has been delivered to Surinam Timber Development Co., Dutch Guiana, for business flying operation.

Republic Steel Corp., ordered its second Howard Super Ventura executive transport; the 21st of the type sold by the San Antonio, Tex., conversion firm. Republic Steels's second plane will have weather radar, Sperry A-12 auto pilot and Bendix and Collins navigation and communications gear.

Cash prize of $300 plus a trophy will be given for best antique airplane flown in to Reading Aviation Service's eighth annual maintenance and operations meeting, Reading, Pa., Municipal Airport, June 1. Cash prizes and awards will also be given to best-in-class current business planes to attend the meeting.

First Edgar Percival E.P. 9 agricultural airplane sold in Europe has been ordered by Ernest Ludt K. G., Hartenholm, Germany, which will use it primarily for spraying fruit crops.

Soviet-designed STOL, engineered by Oleg Antonov, is reported to be capable of taking off from and landing on unprepared strips of 200-ft. length, has a speed range of 21.7 mph. to 124.2 mph. Named the "Bee", the new Antonov STOL is especially designed for novice pilots.

Tally to March 8th of Bell Model 47 helicopter production since it received CAA type certification 11 years ago shows that the company has turned out 1,804 of the rotary wing aircraft as of that date, with 1,082 going to military services. Of the total 382 were manufactured in Buffalo, N. Y.; 1,422 were built in Bell Helicopter Corp.'s Ft. Worth, Tex., plant.

Aircraft sales and brokerage firm, covering leasing and financing, has been formed by Gordon D. Brown at 521 Fifth Ave., New York 17, N. Y.

German Design Mounts Propeller in Tail

Bonn, Germany—Novel two-place power glider/private plane designed to sell for $5,000-$6,000 has been successfully flight tested by Rhein-West Flug Fischer & Co., Porz-Westhofen. Several models, with various powerplants, including a light gas turbine, are projected. Initial production plans call for output of 50 aircraft, most of which have been sold, the maker reports.

Outstanding feature of the RW-3 is tail mounting of its Porsche engine, which drives a pusher propeller located in a gap in the fin. Purpose of this novel installation is to reduce turbulence associated with a normal nose-mounted propeller. Enhanced visibility from the cockpit is another feature. When the RW-3 is used for gliding, the propeller is rotated to a vertical position in the fin slot, reducing drag.

Flug Fischer plan to offer two models of the RW-3:

- **A-2** with wingspan of 49.2 ft. powered by a 65-hp. or 100-hp. Porsche, with range of 560 mi. and 345 mi. respectively. Sea level cruise speed would be 123 mph. with 65 hp.; 143 with 100 hp. Fuel capacity is 15.8 gal.
- **A-3** with 32.8-ft. span, with range of 1,180 mi. with 65-hp. and 890 mi. with 100 hp. Sea level cruise speeds are estimated at 124 mph. and 144 mph. respectively. Additional range is possible because of installation of tip tanks of 15.8-gal. capacity each replacing the deleted wingtip sections.

Porsche is currently developing a 130-hp. engine which Flug Fischer will test in the RW-3. Another project calls for installation of a gas turbine of approximately 550 lb. thrust.

Basic construction comprises welded steel fuselage, plastic covered. Wings are single-spar makeup, with metal spars. Seating is tandem with dual controls, the rear seat slightly above front position, both occupants viewing one instrument panel up front.

Landing gear is retractable tricycle, mechanically operated by a hand lever. Main wheels are fitted with independent brakes.

Skids under the fuselage are provided to take shock of emergency wheels-up landings.

The RW-3 A-2 is designed for a glide ratio of 1:22. Having a powerplant is of considerable assistance in gliding work, since it obviates need for launching gear or a tow plane, although it does compromise optimum glider performance to some extent.

Builder estimates that the RW-3 with a 65-hp. Porsche will cost just under $4 per hour to operate on the basis of 1,000 hr. annually.

FISCHER RW-3 power glider has two versions. This is clipped wing A-3 with tip tanks.

SPACE IN FIN accommodates propeller. Either 65 or 100 hp. engine is also tail mounted.

Fischer RW-3

	RW-3 A-2		RW-3 A-3	
Powerplant (Porsche)	65 hp.	100 hp.	65 hp.	100 hp.
Span	49.2 ft.	49.2 ft.	32.8 ft.	32.8 ft.
Length	24.3 ft.	24.3 ft.	24.3 ft.	24.3 ft.
Height	6.9 ft.	6.9 ft.	6.9 ft.	6.9 ft.
Fuel capacity	15.8 gal.	15.8 gal.	15.8 gal.	15.8 gal.
Empty weight	982 lb.	982 lb.	949 lb.	949 lb.
Maximum gross weight	1,434 lb.	1,434 lb.	1,434 lb.	1,434 lb.
Takeoff run[1]	528 ft.	361 ft.	645 ft.	482 ft.
Takeoff run[2]	655 ft.	550 ft.	855 ft.	720 ft.
Takeoff speed[2]	39.2 mph.	39.2 mph.	46.6 mph.	46.6 mph.
Rate of climb[2]	668 fpm.	1,200 fpm.	590 fpm.	1,100 fpm.
Maximum speed (sea level)	130 mph.	150 mph.	132 mph.	153 mph.
Cruise speed (sea level)	123 mph.	143 mph.	124 mph.	144 mph.
Service ceiling	over 13,000 ft.		over 13,000 ft.	
Lift/drag ratio	26	26	18	18
Fuel consumption	3.1 gph.	4.4 gph.	3.1 gph.	4.4 gph.
Maximum range	560 mi.	345 mi.	1,180 mi.	890 mi.
Landing speed[2]	39.2 mph.	39.2 mph.	46.6 mph.	46.6 mph.

[1]Gross weight, wing tanks full, with pilot only. [2]Maximum gross weight.

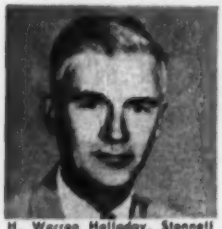
Don Vest, Vest Aircraft & Finance Co., P O Box 5306, Sky Ranch Airport, Denver, Colorado.

W. H. "Bill" Buchanan, Sales Manager, Johnson Air Interests, Inc., Horlick-Racine Airport, Racine, Wisconsin.

Peter Graves, Southern Ohio Aviation Sales Co., Dayton Municipal Airport, Vandalia, Ohio.

John Wilsdon, Hunter Aviation Co., P O Box 122, Lambert Field, St. Louis, Missouri.

Victor "Vic" Bruce, Indianapolis Executive Aircraft Corp., Indianapolis Municipal Airport, Indianapolis, Indiana.

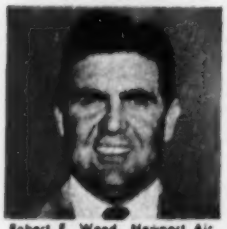


H. Warren Halladay, Stonnell and Halladay, 843 Washington Building, Arlington Towers, Arlington, Virginia

A. M. "Simo" Bertolet, Reading Aviation Service, Inc., Municipal Airport, Reading, Pennsylvania.

H. Leibee Wheeler, Buffalo Aeronautical Corporation, Buffalo Municipal Airport, Buffalo, New York.

John S. Brown, Brown Aero Corp., 3300 Love Field Drive, Dallas, Texas.



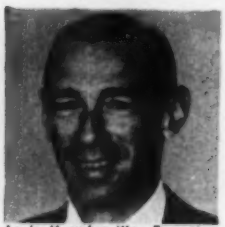
Robert F. Wood, Newport Air Park, Newport, Rhode Island.

Wynn Cronjo, Minnesota Airmotive, Inc., Minneapolis-St. Paul International Airport, Minneapolis, Minnesota.

Norman Hoffman, West Texas Flying Service, Midland Airport, Box 82, Midland, Texas.

Max E. Brand, Aero Commander Dist. (Downtown Airpark), Hangar 3, Municipal Airport, Tulsa, Oklahoma.

E. H. "Ted" Talan, National Aero Sales Corp., Midway Airport, Chicago, Illinois.



Louis Humphreville, Executive Aircraft Corporation, Municipal Airport, Pontiac, Michigan.

W. D. Maddox, Aero Southern Corp., 601 North Broadway, Nashville, Tennessee

O. B. Colton, Fairfax Aviation, Inc., 3301 Fairfax Trafficway, Fairfax Airport, Kansas City, Kansas.

John A. "Jack" Baumon, Santa Monica Aviation, 3011 Airport Avenue, Municipal Airport, Santa Monica, California.

Harrel Bellamy, L. B. Smith Aircraft Corp., Miami International Airport, Miami, Florida.

Lucien M. Tailloc, Trans-Aire Corporation, Pan-Air Building, New Orleans Airport, New Orleans, Louisiana

Jack Gregg, Northern Aircraft Co., International Terminal Building, International Airport, Oakland, California.

Robert M. Brown, Commander Sales Company, Terminal Building, International Airport, San Antonio, Texas.

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USAF Contracts

Following is a list of unclassified contracts for $25,000 and over as released by Air Force Contracting Offices:

AMC, WRIGHT-PATTERSON AIR FORCE BASE, Ohio

AVCO Manufacturing Corp., Lycoming Div., 550 Main St., Stratford, Conn. R1300-3A engines, Air 0503, (PR 708865, 708870, 669626), $1,686,016.

Continental Aviation & Engineering Corp., 12700 Kercheval Ave., Detroit, Mich., YJ69-T-17 engines, A1J3409, (PR 669646, 673617Q), $255,704.

Motorola, Inc., 2710 No. Clybourn Ave., Chicago 14, Ill., indicator, azimuth & range, IP-284/APS, 156 ea.; synchronizer SN-158/APS-64, 60 ea.; position mark generator AN/AWA-2, 21 ea.; (PR 709918, 420316, 717577, 704619, 705139), $1,246,078.

AiResearch Manufacturing Co. of Arizona, Div. Garrett Corp., Sky Harbor Airport, 402 So. 36th St., Phoenix, Ariz., GTC85-82 gas turbine compressor. (installations) (spears) (training command), 141 ea., (PR PE 635613Q), $2,233,018.

Sundstrand Machine Tool Co., Sundstrand Aviation Div., Rockford, Ill., transmission and governor assemblies (B-47 aircraft), (PR PE-635738Q), $1,541,736.

Curtiss-Wright Corp., Wood-Ridge, N. J., Curtiss-Wright Propelier Div., Caldwell, N. J., synchronizer assembly, 279 ea., (PR (WR)-408243-2), $903,627.

Minneapolis-Honeywell Regulator Co., 2600 Ridgway Rd., Minneapolis, Minn., components of type MB-1 automatic pilot system, spare parts, special tools and data, F-101A aircraft, (PR 709790 Amendments 1 and 2), $4,393,473.

Minneapolis-Honeywell Regulator Co., 2600 Ridgway Rd., Minneapolis, Minn., components of type MA-4 automatic pilot system, spare parts, special tools and data, B/RB-66 aircraft, (PR 709794 & Amendments 1 and 2), $689,808.

The W. L. Maxson Corp., 460 West 34th St., New York 1, N. Y., amplifier assemblies, P/N R-55568, K-4 computer, 48 ea.; computer assemblies, P/N R-57099, K-4 computer, 48 ea.; alt. var. trans. P/N B-54160, K-4 computer, 48 ea.; (PR 4080-75), $815,703.

Weston Electrical Instrument Corp., 614 Frelinghuysen Ave., Newark 5, N. J., indicator, ID-351A/ARN or ID-387/ARN, 2,-913 ea., (PR PE-225833, MA-598506, SM-537251, OC-691951, MIPR R-56-747-30-AER, Amendment 1, R-56-842-186-AER), $1,290,-059.

Kollsman Instrument Corp., 80-08 45th Ave., Elmhurst, N. Y., compasses, astro, automatic type MD-1, 42 ea., spares assemblies, spare parts, (RFP PE-670619), $1,-828,966.

General Electric Co., 600 Main St., Johnson City, N. Y., components and spare parts for C-3, C-4, A-5, MD-4, MD-1A & MD-1 fire control systems, (PR WR-433515, -1, WR433523, -1, WR427596, -2, -3, -4, and 718279), $522,121.

The George W. Borg Corp., Borg Div., 120 So. Main St., Jamesville, Wis., loop assembly A8-313B/ARN-6, part of ARN-6 radio compass, a navigational aid used in practically all USAF aircraft; antenna cover for above item; spare parts and data for above items; (PR 670798, MIPR R02-690175-SC-01-23, and Amendments 1 and 2, MIPR R56-841-188-Aer), $471,684.

Lear, Inc., 110 Ionia Ave., NW, Grand Rapids, Mich., indicator, attitude, remote, type MM-2, 3,518 ea.; control, roll and pitch, type K-4B, 2,036 ea.; (PR SM537235, PE670653, PE670654, MIPR R56-1324-226-AER), $4,350,400.

Summers Gyroscope Co., 2328 Broadway, Santa Monica, Calif., indicator, attitude, remote, type MM-2, 2,345 ea.; control, roll and pitch, type K-4B, 1,358 ea.; (PR SM53-7235, PE670653, PE670654, MIPR R56-1324-226-Aer), $3,331,811.

AiResearch Manufacturing Co., of Arizona, 402 So. 36th St., Phoenix, Ariz., starters, pneumatic, type MB-6, 395 ea., (PR 673989 and -1), $543,915.

Solar Aircraft Co., San Diego, Calif., gas turbine generator set type MA-1, model

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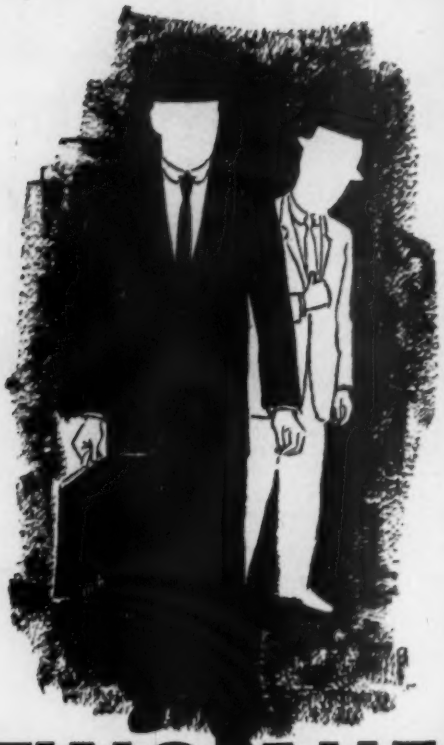

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OF YOURSELF

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Our purpose at Sikorsky Aircraft is to develop and improve what we pioneered — helicopters — the world's most versatile means of transportation. During the few short years since the first meaningful helicopter flight, Sikorsky engineers established many milestones in helicopter progress. Even before each one was recorded, these same men were working with renewed effort to surpass their own achievements.

If, as an engineer, you recognize and appreciate the challenge that exists in the future of rotary-wing aircraft, you know that Sikorsky Aircraft offers the variety of opportunities you need to be able to outstrip your yesterdays by your today.

We would like to tell you more about our company. We hope, too, that you will reciprocate and give us the opportunity to evaluate you. You can do this by writing to Mr. Richard Auten at our Bridgeport Personnel Department.

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SIKORSKY AIRCRAFT
BRIDGEPORT-STRATFORD, CONNECTICUT

T-41M, 200 ea., data, (PR OC-690629Q), $2,049,279.

AiResearch Manufacturing Co., Division of The Garrett Corp., 9851 Sepulveda Blvd., Los Angeles 43, Calif., drive assemblies, constant speed, pneumatic, type MC-1, 40 ea., (PR PE694351), $720,000.

Summers Gyroscope Co., 2328 Broadway, Santa Monica, Calif., indicator, direction gyroscope, type C5C, 1,467 ea., (PR PE670-623, MA718613, MA718614, OC705355, and OC705356), $1,056,240.

Kearfott Co., Inc., 1150 McBride Ave., Little Falls, N. J., indicator, master, 961 ea.; directional control, 204 ea.; control, slaving, 200 ea.; (PR 635957), $2,356,241.

Kearfott Co., Inc., 1150 McBride Ave., Little Falls, N. J., amplifiers, servo, component of J-4 compass, 728 ea.; control directional, component of J-4 compass, 734 ea.; panel, control, component of J-4 compass, 658 ea.; (RFP 635958), $1,808,082.

General Electric Co., Lynn, Mass., acquisition, manufacture, installation and rehabilitation of facilities, (PR 673056), $2,516,-326.

North American Aviation, Inc., Air Force Plant Representative #42, Palmdale, Calif., additional flight test facilities in support of F-100 aircraft production, (PR 603778), $5,000,000.

Republic Aviation Corp., Farmingdale, L. I., N. Y., modification of F/RF-84F mobile training units and procurement of additional trainers, (PR 636003), $487,566.

Air Products, Inc., Allentown, Pa., facilities for the production of liquid oxygen, (PR 180635), $2,703,000.

Otis Elevator Co., Electronic Div., 35 Ryerson St., Brooklyn 5, N. Y., AN/APA-130 interconnecting groups maintenance spare parts, engineering data, revisions to maintenance data, etc., (PR PH671166), $808,486.

The O. A. Sutton Corp., 1812 W. Second St., Wichita, Kan., jettisonable fuel tanks for F-84F and F-102 aircraft (first articles), (PR 672519), $412,610.

Mar-Pak Corp., 1500 W. Jackson St., Painesville, Ohio, reclamation and demilitarization of type B-36 aircraft, (PR 641677, 641677-1, 647677-2), $478,734.

Continental Aviation & Engineering Corp., Detroit, Mich., acquisition, supply, design, manufacture, construction, rehabilitation and installation of facilities for the production of gas turbine compressors, (PR 673-065), $1,500,000.

Canadian Commercial Corp., Washington, D. C., L-20A airplanes and related supplies for the Dept. of the Army, 1 L-20A airplane for MDAP, (MPR R-56-618-TC, R-56-619-TC), $2,169,613.

General Dynamics Corp., Convair Div., Air Force Plant #4, Fort Worth, Tex., additional facilities for B-58 program, (PR 701121), $308,000.

Eaton Manufacturing Co., Aircraft Div., Battle Creek, Mich., acquisition, rehabilitation and installation of machinery and equipment for the production of blades, (PR 603779), $1,500,000.

Douglas Aircraft Co., Inc., Tulsa, Okla., facilities in support of C-132, (PR 565054), $6,745,000.

Boeing Airplane Co., Wichita, Kan., facilities for B-52 aircraft production, (PR 701118), $935,000.

Pacific Airmotive Corp., 2940 N. Hollywood Way, Burbank, Calif., IRAN maintenance F-86A/E and F-86F type acft. (PR SM-536835, SM-536835-1 and SM-536836), $750,000.

Hayes Aircraft Corp., Birmingham, Ala., IRAN of B-50 acft. and modification of B-50 acft. to the KB-50 configuration, (PR 732805), $713,000.

Temco Aircraft Corp., Greenville, Tex., IRAN maintenance, fuel tank deseal and reseal and electronic modification of C-54 acft., (PR SB-554258), $2,937,675.

Hayes Aircraft Corp., P. O. Box 2287, Birmingham, Ala., IRAN and modification of RB/TB/WB/B-50 acft., (PR OC-705551 and OC-666279), $400,000.

Collins Radio Co., Inc., Cedar Rapids, Iowa., vertical gyro, course indicator, steering computer with shock mount, F102B, C-130A components, (PR 708067 and 708-067-1), $1,299,098.

Kaiser Aluminum and Chemical Corp., P. O. Box 749, Newark, Ohio, for operation

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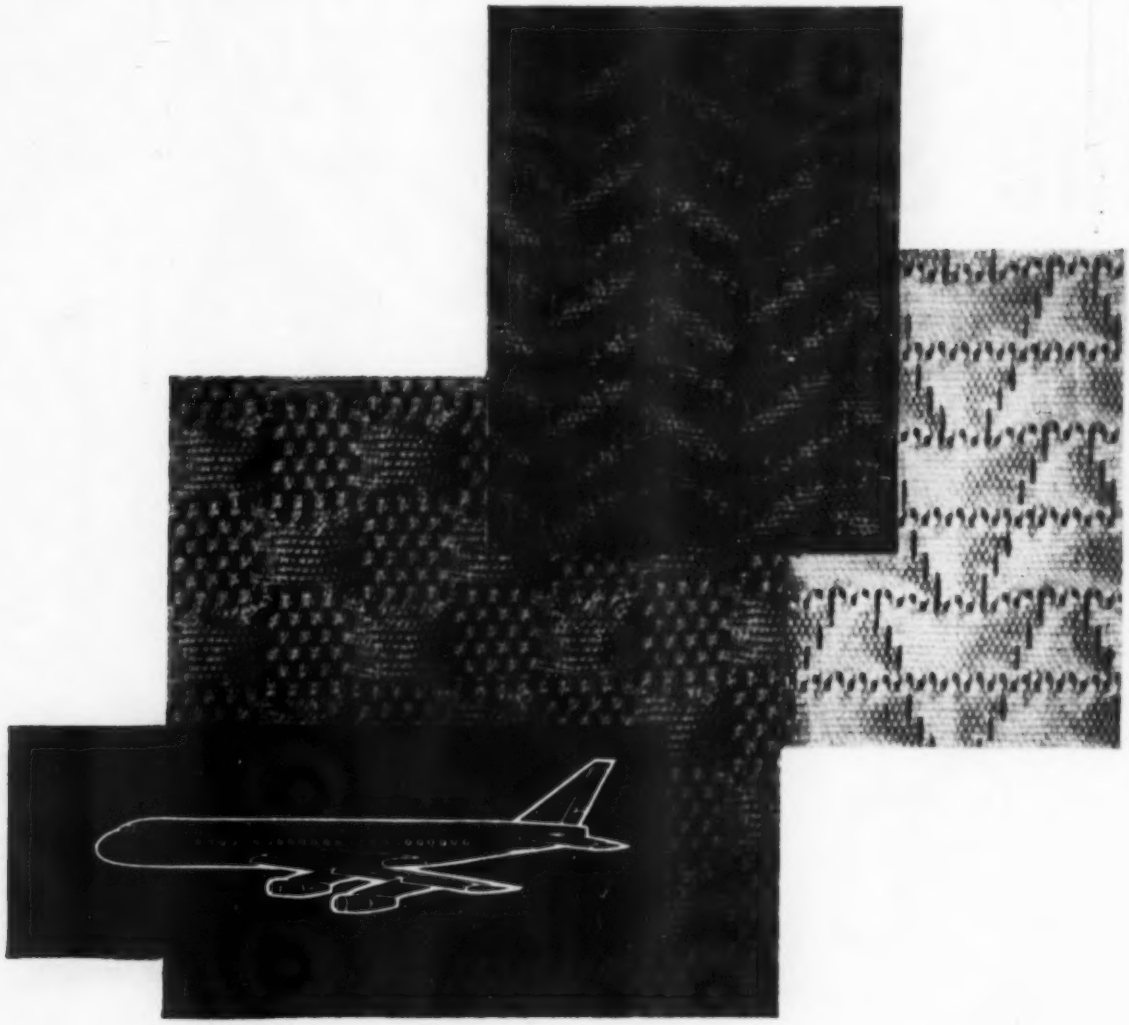

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TITANIUM IN THE BOEING B-52 saves 400 pounds in gross weight. Jet engine pods for this history-making, global bomber are fabricated by Bell Aircraft Corporation from titanium supplied by Republic and other producers. Titanium was selected for this application because of its lightness, strength, and corrosion-resistance. It offers the highest strength-to-weight ratio of construction metals. Titanium's extremely high corrosion-resistance makes it attractive for missile applications, such as fuel tanks. Nitric acid has little effect on titanium. It is immune to the corrosive action of salt water and sea air. Write for more facts.

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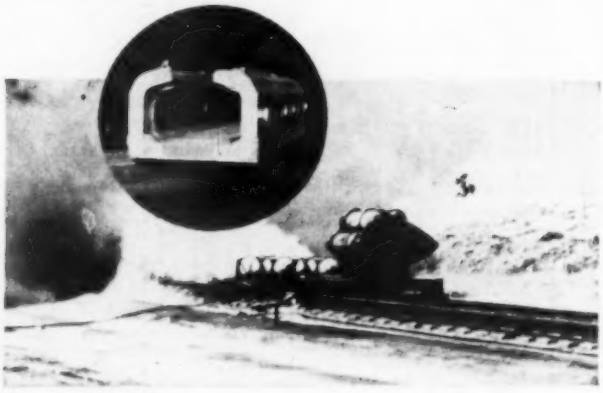
Now that the sound barrier has been passed and the next goal in sight is the "thermal thicket," material selection becomes even more important. To date two materials, titanium alloys and stainless steel, best qualify to meet high skin temperatures resulting from aerodynamic heat. Republic produces both of these metals in billets, hot rolled and cold finished bars, plates, sheets, and strip.

Republic Alloy Steels have played a prominent part in the development of operating and structural parts free from excess weight, yet tough and strong to withstand shock, impact, strain and vibration.

Our metallurgists and engineers are always available to work with your own personnel in using these Republic products to best advantage. The service is obligation-free and confidential. Send us the coupon if you would like metallurgical assistance.

ALLOY STEEL IN THE NORTH AMERICAN F-100 landing-gear struts provides strength, toughness, maximum resistance to fatigue. The struts are made by Bendix Product Division, Bendix Aviation Corporation. Exacting requirements for inner and outer cylinders resulted in the development of new grade of steel by Bendix and Republic metallurgists working in cooperation with North American engineers. This new steel, designated AMS 6427, was found ideal for application in the strength range of 220,000-240,000 psi. It maintains its great strength at wide temperature extremes. Republic metallurgists are available to help with your projects.



STAINLESS STEEL HELPS SPEED ROCKET SLED to world's record of 1560 miles an hour. The sled, designed and built by Convair Division of General Dynamics Corporation, is used in supersonic tests to evaluate the effect of rain erosion on aircraft and missile parts. The sled rides rails on slippers made of SAE 4130 Alloy Steel. Within each slipper (see photo inset) are stainless steel inserts, Type 321, of which Republic is a supplier. The inserts serve as a lubricant to reduce friction by shucking off metal particles at a temperature of 1500°F. The stainless inserts reduce friction so effectively that engineers no longer take it into account in calculations of sled performance.

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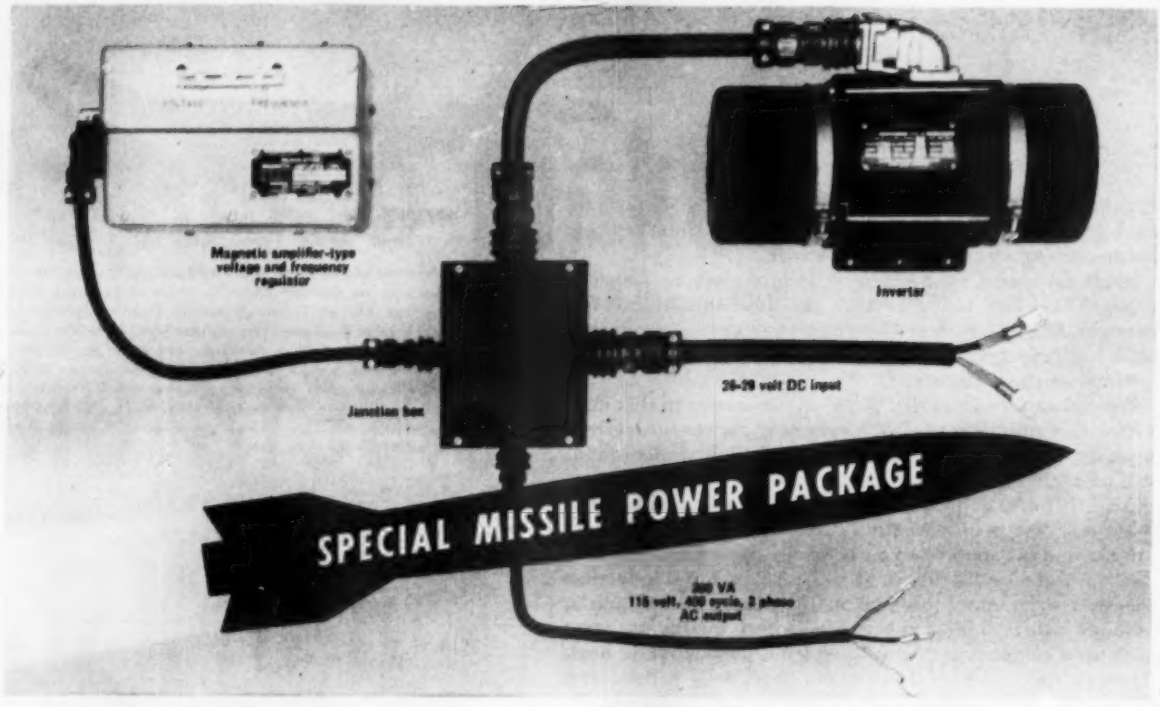

An example of the Bendix Red Bank complete line of high-altitude and missile inverters

As aircraft and missile performance continue to step up, Bendix Red Bank designers continue to lead the field in developing new, high-performance inverters and power packages.

We now offer a complete line of inverters from 6 VA to 5,000 VA, including advanced special-application units and missile type power packages like the one shown above.

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INVERTERS — 400-CYCLE OUTPUT

Type	Input		Rated Output			Max. Altitude at Rated Output	Approx. Wt. Lbs.	Designed to Gov't. Part No.
	Volts	Amps.	Volts	Phase	VA Rating			
12128	27.5	1	26	1	6	35,000	2.2	AN3496
12126	27.5	2	26	3	10	35,000	2.3	E1615
32B21	27.5	3	115	1	20	50,000	5	—
MG-93	27.5	12	115/200	1 3	100 100	65,000	10	E5134
MG-54	27.5	22	115/200	1 3	250 250	50,000	17	E5109
12142	27.5	22	115	1 3	250 250	35,000	13	E1617
12143-1	27.5	22	115	3	250	35,000	13	—
12143-2	27.5	22	115	1	250	35,000	13	—
*32B15	27.5	22	115	3	300	50,000	14	—
32E01	27.5	35	115	3	500	50,000	26	AN-3533-1
32E00	27.5	51	115	1 3	500 750	50,000	34	AN-3534-1
MG-65	27.5	52	115/200	1 3	750 750	50,000	35	E52805-2
MG-61	27.5	126	115	1	1750	50,000	54	53C6767
1518	27.5	126	115	1 3	1500 1800	20,000	37	—
32E06	27.5	160	115/200	1 3	2000 2250	50,000	56	E1725
32E03-3	27.5	150	115	1	2500	50,000	58	53B6227
*32E03-8	27.5	160	115	1	2500	50,000	65	53B6227
*MG-77	27.5	150	115/200	3	2500	50,000	65	—
*32B49	27.5	160	115/200	1 3	2500 2500	50,000	65	E54807
MG-81	27.5	160	115/200	1 3	2500 3000	50,000	61	E1725
MG-95	27.5	160	115/200	1 3	2500 3000	50,000	58	E54807
32E09	27.5	160	115	1 3	2500 3000	50,000	60	—
32B27	27.5	285	115/200	3	3500 4000	50,000	76	—

*These inverters have magnetic amplifier "static" type voltage and frequency regulators.
NOTE: D.C. Input Voltage shown is nominal value of 27.5 volts, but all units are designed for 26 to 29 volt operation. Input amperes shown are rated at 27.5 volts input.

Red Bank DIVISION

Bendix AVIATION CORPORATION

and maintenance of USAFDIER storage site No. 4, Newark, Ohio, (PR 143225 and 180753), $443,369.

The Rand Corp., Santa Monica, Calif., facilities for air defense system training program, (PR 673170), $253,300.

Thompson Prod., Inc., Cleveland, Ohio, acquisition, rehabilitation and installation of facilities for J-79 engine program, (PR 673132), $5,000,000.

Air Products, Inc., Emmaus, Pa., facilities for the production of liquid oxygen, (PR 673169), $2,810,000.

The Tumpane Co., Inc., USAFDIER Storage Site 7, Terre Haute, Ind., services: maintenance and operation of war reserve machine tool storage site, (PR 143203, PB-143203-1, 709270 and 709257), $756,028.

The Tumpane Co., Inc., USAFDIER Storage Site 6, Marietta, Ga., services: maintenance and operation of machine tool storage site, (PR 143245 and 180747), $1,-942,514.

William J. Graham & Son (dba), Graham Aviation, Edward Gary Air Field, San Marcos, Tex., operation of an Army fixed-wing primary pilot training program, (PR 669918), $394,000.

Pacific Airmotive Corp., 2940 N. Hollywood Way, Burbank, Calif., IRAN reconditioning, modification and flight test of C-47/C-117 type acft., (PR SB-554269), $5,494,-256.

Butler Mfg. Co., 7400 E. 13th St., Kansas City 26, Mo., first article-type L-6 oil serv. truck, spare parts, maintenance tools, (PR MP-568074, -1 and -2, MP-568165 and -1), $1,869,591.

Utica-Bend Corp., 50500 Mound Rd., Utica, Mich., overhaul of J-47 GE-25/25A type a/c engines, (PR OC-720520), $3,692,-500.

Lockheed Aircraft Corp., Burbank, Calif., reconnaissance supporting system for SAC and TAC project "Monticello I", (PR PM-199332), $1,859,400.

Southwest Airmotive Co., Love Field, Dallas, Texas., overhaul J33-A35 A/C engines, (PR OC-732757) $1,383,840.

Aircraft Engineering and Maintenance Co., Municipal Airport, Oakland, Calif., IRAN maintenance and modification of F-80 type aircraft, (PR SM-536840), $750,000.

AVCO Manufacturing Corp., Crosley Div., Cincinnati 15, Ohio, fire control systems, bomber flexible tail, defense, type MD-9 for B-52, (PR 709895, 709895-1, 709807, 709807-1, 709797, 709797-1, 709868), (PR 709895, 709895-1, 709807, 709807-1, 709797, 709797-1, 709868, 709852, 218559 and 218559-1), $25,150,558.

Gilfillan Brothers, Inc., 1815 Venice Blvd., Los Angeles, Calif., 9480-5435-2 and -3 actuator, 340 ea., maintenance data., (Pr SA-723388 Q), $94,203.

General Precision Laboratory, Inc., 63 Bedford Rd., Pleasantville, N. Y., amplifier, electronic control AM-946/APN-89, 84 ea., (PR PE-670799), $323,754.

Safe Flight Instrument Co., 4 Water St., White Plains, N. Y., 9481-22300 vibrators, non-synchronous, 1,565 ea., (PR SA-723383 and -1Q), $118,392.

Bendix Aviation Corp., Bendix Products Div., 401 Bendix Drive, South Bend 20, Ind., wheel assy., AIW-1012, 62 ea., brake assy. AIV-1107, 165 ea., (PR PE-671353 and PE-546246), $209,629.

Lockheed Aircraft Corp., Marietta, Ga., additional funding action for modernization of C-130A airplanes, (PR PH-205029), $865,000.

Boeing Airplane Co., Seattle, Wash., modification of C-97-4 and C-97-5 mobile training units, (PR PH-221648 and PH-221709), $327,953.

Allison Div., General Motors Corp., P. O. Box 894, Indianapolis 6, Ind., services and supplies necessary to modify and convert J33-A-33/33A engines to the following: J33-A-37 turbo-jet aircraft engines (TM 616 missile) and J33-A-41 turbo-jet aircraft engines (YTM 61B missile), (PR 672907, 672875 and 672898), $2,446,600.

General Electric Co., French Rd., Utica, N. Y., spare components for APG-41B, radar set, (PR WR-407604, WR-407604-1, WR-427596, WR-427596-2), $139,268.

Sperry-Rand Corp., Sperry Gyroscope Co., Marcus and Lakeville Rd., Great Neck, N. Y., components for E-4 autopilot to be

Valve Talk

FOR WM. R. WHITTAKER CO., LTD.

BY MARVIN MILES

The bright-red Hellcat drone clattered across the sky, a World War II veteran sentenced to die for the proof of technology.

Far aft, an F3H Demon broke out of the overcast in a shallow dive and headed for its fleeing quarry.

The shrill-whining Demon closed rapidly to three thousand yards, then a sliver of fire detached itself from the jet and streaked for the Hellcat at supersonic speed.

A burst of orange flame marked the perfect hit that blew the tail completely off the target plane. The Hellcat staggered on for a second or two amidst a shower of its own debris before falling off into a flat spin that steepened to explosive impact on the desert floor.

The Navy's Sidewinder guided missile had proved its venom in first public demonstration.

Had the target been an enemy jet at high altitude the result would have been the same, for the blunt-nosed Sidewinder follows its prey tenaciously despite evasive maneuvers and strikes with the viciousness of the desert rattlesnake for which it is named.

A long, slender missile, measuring 9 feet, 5 inches and weighing some 155 pounds, the Sidewinder was developed from drawing board to acceptance trials by the Naval Ordnance Test Station, China Lake, Calif. – the first operational weapon of its type ever achieved by a government laboratory.

And credited with its success is a quiet, almost shy, bespectacled scientist, Dr. William B. McLean, station technical director, who pushed and pulled the missile through years of development starting in 1951 and received the nation's highest Civil Service incentive award of $25,000 for his role in the project.

Bill's design philosophy integrated three basic principles throughout the development: The Sidewinder must be accurate and highly reliable, he decreed. It must be simplified for producibility and cost reduction and as a new weapon system it must meet the specific needs of the fleet.

All three goals were achieved in the missile and one reason for its success was the Navy's willingness to concentrate all technical responsibility and authority in the staff at the Naval Ordnance Test Station.

Its accuracy and reliability have been proved. On one of its early test shots it brought down a B-17 drone even without a warhead. Later its sharpshooting characteristics were further defined when it knocked off a Matador missile, according to reports.

The weapon's simplification is shown by the fact that it has few moving parts and contains little more electronics than the average radio. These features have brought its cost down to a current $1600 per copy, I hear, and this figure probably can be halved when it reaches mass production.

Furthermore – although no weapon system is universal – it meets a particular tactical need without making any real sacrifice in over-all tactical usefulness.

The death of the Hellcat was awesome in the inexorable manner of an execution.

Even before the missile was launched the seeking eye in its nose was buzzing – rattlesnake-like – as it caught and held the infrared rays emitted by flares on the drone which simulated jet exhaust.

At the instant of launch the seeker was transmitting flight intelligence to canard control surfaces on the Sidewinder's nose section, then followed through with minute changes in course as the missile flashed toward its target at better than twice the speed of sound.

Its streaking flight lasted no more than a few heartbeats – a distant toothpick pushed by a thin stream of fire from its solid propellant motor. Then it rammed the drone with terrific impact that detonated an estimated five pounds of high explosive in its warhead. A blast of flame and flying chunks marked the Hellcat's death throes. It was all over but the spin and the blazing finale.

It could have been fired at high altitude at an enemy jet bomber. It could have executed 10 to 14-G turns to cut off and intercept an evasive target. It could have scored a kill and perhaps prevented an atomic holocaust.

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The development of Esso Aviation Turbo Oil 35 is just one more example of Esso's continuing leadership in creating new and better fuels and lubricants for the new and better aircraft of today—and tomorrow.

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used for C-118, C-74, C-131B type aircraft for spares, (PR MA-597729), $538,946.

Curtiss-Wright Corp., Propeller Div., Caldwell, N. J., propeller assemblies (Inst) and (spares) controls, all for support of ZSG-1 airships, (MIPR R56-1059-154 and Amendment 1), $588,292.

Bendix Aviation Corp., Red Bank Div., Eatontown, N. J., generators, 20 KVA, A. C., regulators, voltage, panels, control, A. C. for F104A aircraft, (PR PE-694310), $1,137,791.

Boeing Airplane Co., Seattle, Wash., facilities for the production flight testing of B-52 aircraft, (PR-630769), $4,706,000.

Fritz J. Russ /DBA/ Systems Research Laboratories, 300 Woods Dr., Dayton 3, Ohio, maintenance and operation of OARAC and operation only of ERA 1103 computers at Building 57, WADC, Wright-Patterson AFB, Ohio, (PR 22882), $135,599.

Bill Jack Scientific Instrument Co., Solana Beach, Calif., D-3 Chassis, 115 ea, D-2 Chassis, 115 ea, B-2 Mounting Base, 214 ea, (PRs 564633, 564633, 564627, 664627, 664631, 564634, MO-671433, amend-1, 664145, 664,-169, S/A 692k46), $376,963.

The Goodyear Tire and Rubber Co., Inc., 1144 East Market St., Akron 16, Ohio, Wheel Assembly, 26x6 Brake Assembly (for 26x6, Wheel), Brake Assembly (for 26x6.6 For T-33A Aircraft), (PR PE-564240-1), $267,166.

Airesearch Manufacturing Co. of Arizona, Div. of the Garrett Corporation, Phoenix, Ariz. Starters, pneumatic aircraft Engine LNER no. 2-6317, (PR PE-670607), $624,456.

RCA, Point and Cooper Sts., Camden 2, N. J. Receiver-Transmitter RT-128A/AIC-21 551 ea, Control Panel C-451A, ARC-21, 408 ea, Power Supply FP-298/ARC-21X, 455 ea, (PR PE-670890 and 570830), $7,-206,912.

Boeing Airplane Co., Seattle, Wash, KC-135A Fuselage, (R PH-673009) $998,231.

Boeing Airplane Company, Wichita, Kans, Modification of mechanical and electrical B-47 MTU's together with training transparencies, (PR PH-209873) $480,000.

Boeing Airplane Co, Seattle, Wash, Model RC-135A Airplane designed and fabricated in accordance with contractor's model (Spec D-15441 PR PH209873) $50,000,000

Sikorsky Aircraft, United Aircraft Corp., Stratford, Conn, H-19D Air Force Helicopters with Spare, GHE, and Data (PR 709504 and 709521) $972,000.

Helicopter Division of Bell Aircraft Corp., Fort Worth, Texas YH-40 Helicopters spare parts, ground support equipment, data and so forth, (MIPR R-56-691-TC) $1,500,000.

General Electric Company, Syracuse, N. Y. Facilities to support of the WS-107A Program, (PR 630774) $860,828.

AC Spark Plug Div., General Motors Corp, Milwaukee, Wis, Facilities in support of the WS-315A Program, (PR 565,108) $2,084,934.

Aerojet-General Corp, Sacramento, Calif, Facilities for the support of the WS 107A Program, (PR 630528 and 604354) $10,-506,486.

American Bosch Arma Corp, Garden City, N. Y. Facilities for the support of the WS-107A Program, (PR 70114) $175,000.

Thompson Products, Inc, Cleveland, Ohio, Preparing facilities for shipment, (PR 630773) $640,000.

Dow Chemical Company, Midland, Mich, Additional facilities for the production of aircraft extrusions, (PR 630755) $175,000.

AF OFFICE OF SCIENTIFIC RESEARCH, ARDC, Washington 25, D. C.

Fairchild Engine Div. of Fairchild Engine & Airplane Corp., Deer Park, L. I., N. Y., research in supersonic combustion, (AF 49 (638)-15), job, $209,360.

Cornell Aeronautical Laboratory, Inc., 4455 Genesee St., Buffalo 21, N. Y., research on "Hypersonic Research Apparatus", (AF 18(603)-141), job, $1,499,944.

AIR FORCE MISSILE TEST CENTER, Patrick AFB (ARDC), Fla.

General Dynamics Corp, (Convair Div,) San Diego, Calif, Design, Development, and Fabrication of Azusa Tracking Equipment Operational Model (Mark II) (PR RF-1 (56) 243 & RF-1(56)-276), job, $2,495,593.

Collins Radio Company, 855 45th St, N.W. Cedar Rapids, Iowa, 10 KW CHG Command

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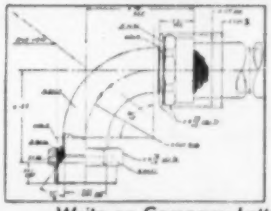

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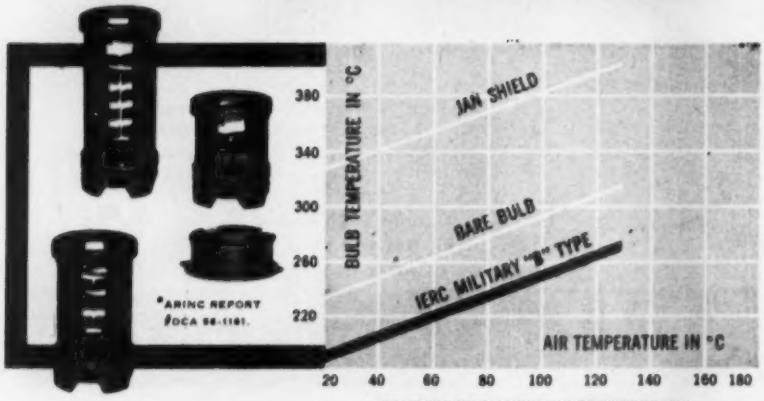

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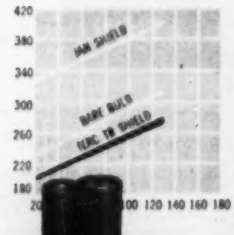

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Control Amplifiers, (P.R. FP-1(56)-413, Job, $276,290.

Radiation, Inc, P.O. Drawer 37, Melbourne, Fla Five automatic tracking telemetry antennas, (P.R. FP-1(56)-446) job, $1,414,520.

The Perkin-Elmer Corp., Norwalk, Conn, Recording Optical Tracing Instrumentation Systems and installation (P.R. FP-1(56) -281 & P.R. Fp-1(56)-364) job, $1,480,090.

Reeves Instrument Corp. 215 East 91st St, N. Y. 28, N.Y. AFMTC Model II Radars, Shelters Services and Instruction Manuals (P.R. FP-1(56)-380) job, $1,040,167.

ROME AIR FORCE DEPOT, Griffiss Air Force Base, N. Y., July 24.

General Electric Co., Electronics Park, Syracuse, N. Y., de-multiplexer group OA-979/GKA-4, 59 ea.; flight control group AN/GKA-4, 7 ea.; de-multiplexer test signal generator, 49 ea.; (RFP 30-635-56-4699Q), $2,089,945.

Lewyt Manufacturing Corp., 43-22 Queens St., Long Island City, N. Y., coordinate data monitor OA-947/FST-1, (PR 681679), 78 ea., $612,300.

Hazeltine Electronics Corp., 59-25 Little Neck Parkway, Little Neck 62, L. I., N. Y., indicator group AN/UPA-35, (RFQ 30-635-56-4735Q), $4,322,563.

Northern Radio Co, Inc, 149 W. 22nd St. N Y. 11, N. Y. Frequency shift diversity convarier, 218 ea, (RFP 30-635-56-4627Q) $297,897.

Northeastern Engineering Inc, 25 S. Bedford St, Manchester, N. H. SSZ-34 Crypto terminal rack, 1445 ea, (IFB 30-625-56-218B) $443,430.

Wilcox Electric Co, Inc, 1400 Chestnut St. Kansas City 27, Mo, Wilcox type 482A TVOR 43 ea, (RFP 30-635-56-4614Q), $285,-605.

Salyers Equipment So, 728 East Washington Blvd, Los Angeles Cal, Generator set diesel engine trailer mounted for radar sea AN/MPN-11 (RFP 30-635-56-5004Q), $1,-158,930.

Philco Corporation, 4700 Wissahickon Ave, Philadelphia, Pa, CLR-6 and CLR-7 Microwave equipment (RFP 30-635-56-461-5Q) $903,109.

Firestone Tire and Rubber Co, of Canada Ltd, Burelington St, East Hamilton, Ontario Canada, Radome, CW-208C/CPS-6B (IFB 30-635-56-311B) 60 ea, $603,960.

Gilfillan Bros., 1815 Venice Blvd., Los Angeles, Cal, AN/MPN-11 radar set, (RFP 30-635-56-4560Q) $6,495,525.

WARNER ROBINS AIR MATERIEL AREA, Robins AFB, Ga.

Hughes Aircraft Co., Culver City, Calif., Reflector, 1,000 ea; Receiver transmitter sub-assy, 18 ea; Wave-guide assy, 270 ea; (IFB-390) $204,878.

Hughes Aircraft Co., Culver City, Light filter assy, 1512 ea; Synchro transformer, 1425 ea; Gear assy, 1470 ea; applicable to FCS systems (IFB-428) $297,937.

Hughes Aircraft Co, Culver City, Modification kits to rework FCS receiver-transmitter, (PR 00-4498090 & 00-555314) 222 ea, $171,903.

Radio Corp. of America, Camden, N. J. Waveguide elbow, 4942 ea; electric contract assy, 1335 ea; antenna control, 476 ea; (IFB-428) $321,057.

John Oster Mfg. Co. Racine, Wis. Motor AC, 50/26F, 400 Cyclo; & ph. 1626 ea; motor, AC shaded pole induction type; 4520 ea; applicable to APs-23 radar set (IFB-411) $220,277.

Servo Mechanisms, Westbury, N. Y. Repair/modification of Range Servo and Angle of Attack Computer components (PR-7348-40 and 584480) $309,239.

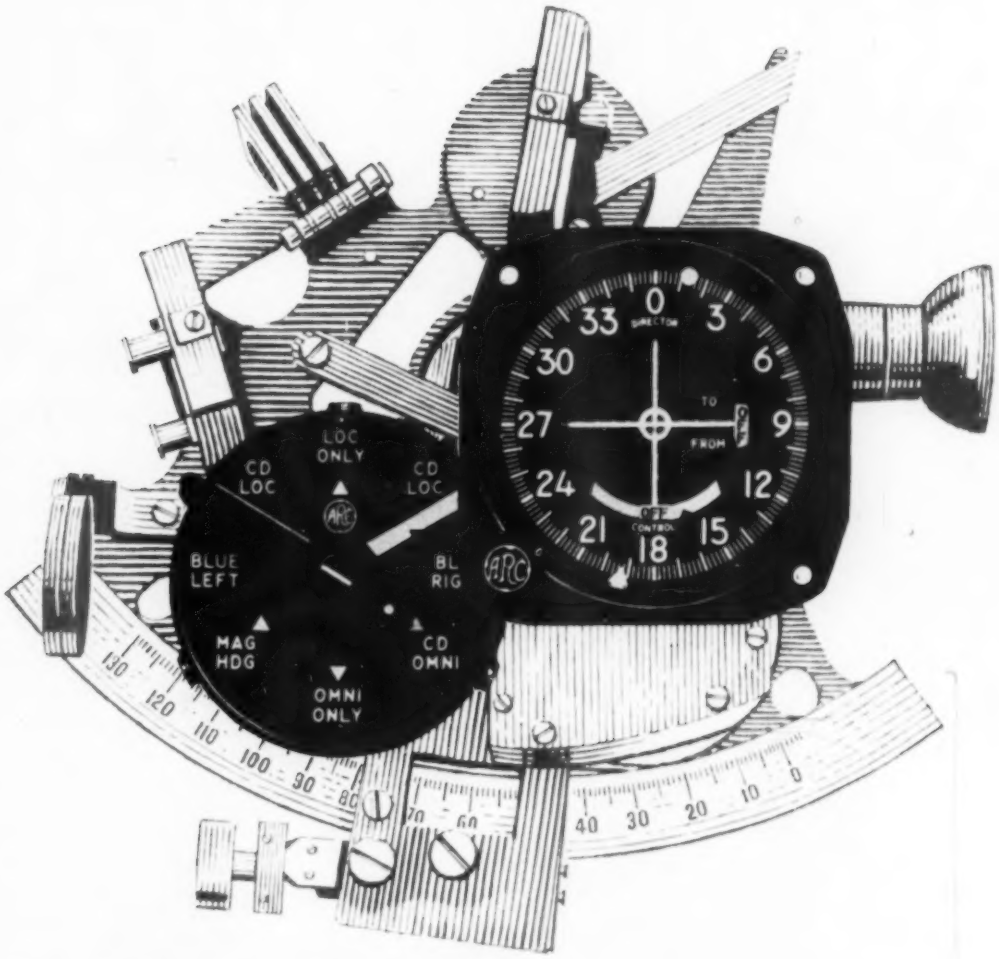
AC Spark Plug Div. GMC, Milwaukee, Wis. Modification kits for K system BNC (PR-681250 and 20 other PR's) $936,146.

AC Spark Plug Div, GMC, Milwaukee, Wis, Modification kits for A-1A BNC systems (PR 681223 and OC-691811) $421,701.

General Electric Co., Johnson City, N. Y., modification kits applicable to tail computers (PR-433561), $117,109.

Sperry Gyroscope Co., Great Neck, N.Y., modification kits for transmitters, controls and converters, $341,594.

Curtiss-Wright Corp., Caldwell, N. J., repair, modification, repair and packaging



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electric propeller assys., (PR-734970) $265,000.

General Mills, Inc., 1620 Central Ave., Minneapolis 13, Minn., spare parts for Y-2, Y-3 and Y-4 periscopic bomb sights (IFB-369) various quantities, $438,344.

Western Electric Co., Winston Salem, N. C., gear assy., gear reduction assy., gear reduction unit etc. for AN/APA-44 series ground position indicators, (IFB-420), $163,268.

Servomechanisms, Inc., Westbury, N. Y., amplifier assys., angle of attack positioners, mount assys., etc., applicable to E-series fire control systems, (IFB-382), $261,687.

A. C. Spark Plug Div., GMC, Milwaukee, Wis., amplifier assemblies and other spare parts applicable to the A-1 and A-1A bombing navigational systems, (IFB-399), various quantities, $1,111,129.

A. C. Spark Plug Div., GMC, Milwaukee, Wis., clutch assembly, motor, network, and plate assembly, etc., for A-1 and A-1A bombing navigational systems (IFB-433), various quantities, $1,197,260.

MIDDLETOWN AIR MATERIEL AREA, Procurement Div., Olmsted AFB, Pa.

Bell Aircraft Corp., Helicopter Div., Ft. Worth, Texas, IRAN of H-13 type aircraft, PR MA-650807, 30 ea., $100,000.

Canadian Commercial Corp., Ottawa, Province of Ontario, Canada, IRAN of type L-20 aircraft, PR MA-650805, 51 ea., $100,000.

Fairchild Engine & Airplane Corp., Fairchild Aircraft Div., Hagerstown, Md., IRAN, flight test & preparation for delivery of type C-123 aircraft, 38 ea., PR 701681, PR 701681-1, $817,000.

Zenith Instrument Co., Inc., 523 Forest Ave., Paramus, N. J., release assy., parachute ripcord, 5,000 ea., IFB PR 662733, $254,822.

Decker Aviation Corp. 1361 Frankford Ave., Philadelphia 25, Pa., repair and modification of components of the type A-12D autopilot 1,400 ea. 273,651.

Vertol Aircraft Corp. Morton, Pa., services for the repair and/or overhaul of H-21 transmission and rotor hub assemblies 943 ea, $277,672.

United Aircraft Corp. Sikorsky Aircraft Div, Stratford, Conn., services and material necessary to repair and/or overhaul of H-5, H-18 and H-34 rotor blades 818 ea, $343,930.

Irving Air Chute Co. Inc, 1315 Versailles Road, Lexington, Ky., parachute, aircraft approach 2,000 ea, (RFP PR MA 564170, 650104, $281,288.

Weston Electrical Instrument Corp., 614 Frelinghuysen Ave., Newark 5, N. J., meters, ruggedized electrical, PR MA-718664, MA-718563, MA-718652, MA-718652-1, MA-718651, MA-718654, 8259 ea., $215,014.

OKLAHOMA CITY AIR MATERIEL AREA, Tinker AFB, Okla.

Adel Precision Products, Division of General Metals Corp., 10777 Vanowen St., Burbank, Calif., valve assembly, solehold (RFP 57-031-1 OC-691180) 2 items, $123,543.

Fairchild Engine and Airplane Corp., Stratos Div, Bay Shore, Long Island, N. Y. overhaul and modification of B-47 refrigeration units (OC-730188, OC-730189), job, $757,448.

Boeing Airplane Co., Wichita, Kans., service and assistance to the Air Force in support of B-52 field modification, (OC-729533), job, $200,000.

Boeing Airplane Co., Wichita, Kans., service and assistance to the Air Force in support of B-52 field modification, (OC-729538), job, $200,000.

Aviation Electronics Inc., 1026 N. Mosley, Wichita 5, Kans., jet engine run-up control assy. (IFB 34-601-476), 1 item, $958,800.

The Garrett Corp., AiResearch Mfg. Co., of Arizona, 402 S. 36th St., Phoenix, Ariz., overhaul and repair of gas turbines, (OC-729614 & C1), job, $275,471.

MOBILE AMA, Brookley AFB, Ala.

Lord Manufacturing Co., Erie, Pa., refabrication of Lord core assemblies contract Nr. AF 01(601)19993 Class 03-5 3 items, 19400 ea., $114,819.

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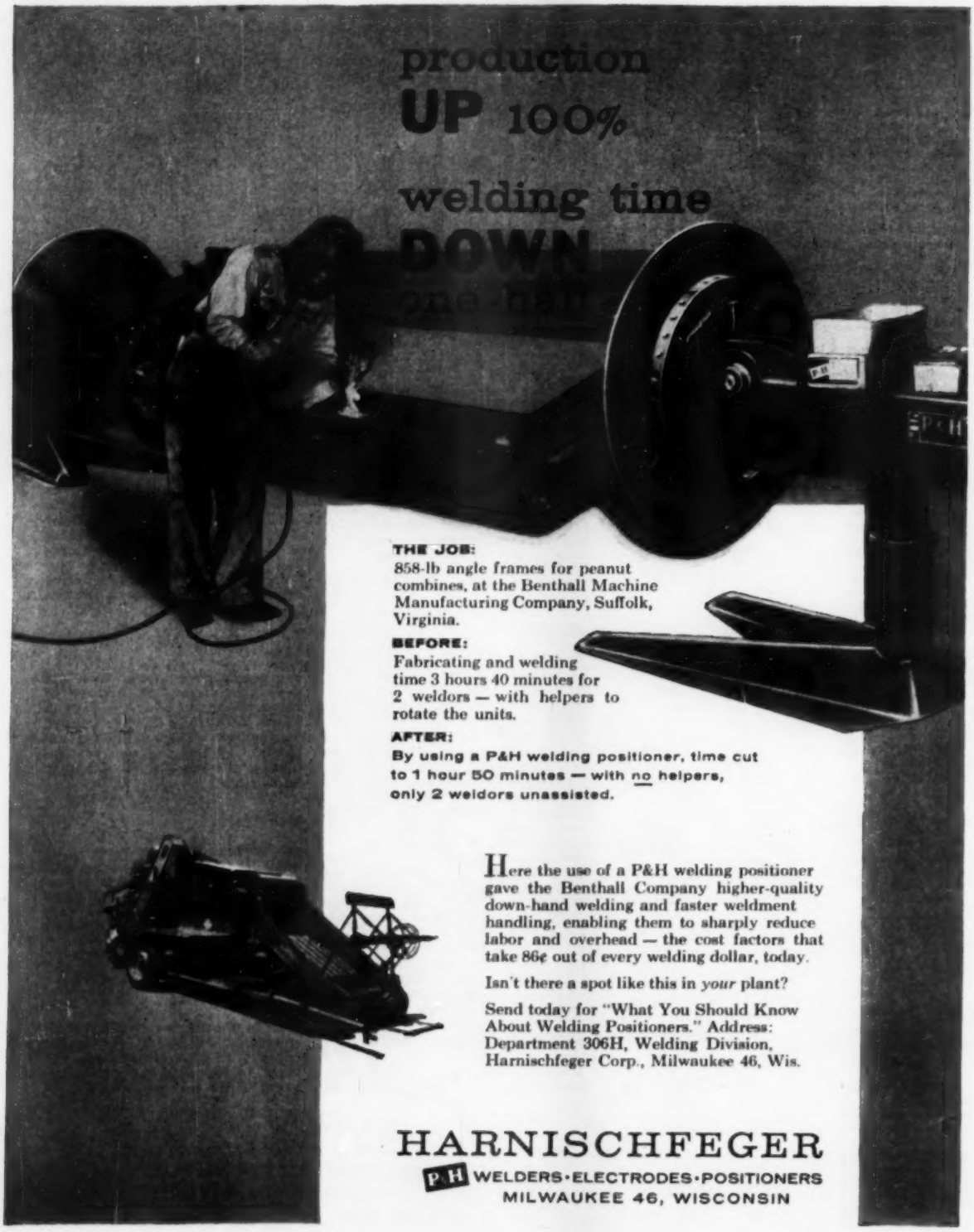

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New Haven, Conn., refabrication of MB core assemblies, Contract Nr. AF 01(601)20020 Class 03-J 11 items, 15450 ea., $192,925.

Republic Aviation Corp., Farmingdale, L. I., N. Y., modification of F-84F aircraft, contract Nr AF 01(601)19858 Class 01-A, 1 item, 484 ea., $95,777,817.

Bendix Aviation Corp., Utica Div., Utica, N. Y., repair and modification Bendix 36E23 starters, contract Nr AF 01(601)19875 1 item, 691 ea., $345,125.

OGDEN AMA, Hill AFB, Utah.

Curtiss-Wright Corp., 631 Central Ave., Carlstadt, N. J., contractual maintenance of flight simulators, Class 28A, (PR 00-555372), $2,273,141.

General Motors Corp., Allison Div., Aeroproducts Operations, Municipal Airport, Dayton 1, Ohio, modification and overhaul of 900 model AAHL-A series actuators, contractor furnished parts and rework of valve assemblies, Class 03G, (PR's 00-78656 and 00-786756-1), $385,200.

Elmhurst, N. Y., altimeters (PREN11-1256/57), various, $288,803.

NAVY DEPT., Bureau of Aeronautics, Washington 25, D. C.

Motorola, Inc., 4545 W. Augusta Blvd., Chicago 51, Ill., retrofit kits for AN/APS-31 and -33 radar sets, NOas 56-683-f(PD-36-804-56), 658, $693,599.

Packard-Bell Co., 12333 W. Olympic Blvd., Los Angeles 64, Calif., RT-261/APX-7 radar recognition sets, NOas 56-997-f(PD-31-771-56), 170, $394,652.

Master Specialties Co., 956 E. 108th St., Los Angeles 59, Calif., automatic parachute pack openers, NOas 57-289-f(AE 52-1880-57), 1000, $124,292.

Westinghouse Electric Corp., 1625 K Street N. W., Washington 6, D. C. Modification and overhaul of government-owned J46-WE-8A turbo jet engines to the J46-WE-8B configuration NOas 56-527-f(MA-44-5010-56), 39, $496,353.

Hazeltine Electronics Corp., 5625 Little Neck Parkway, Little Neck 62, Long Island, New York. AN/APS-20E radar acts, NOas 56-633-f(PD31821-56 and 785-56), 126, $3,240,557.

The Garrett Corp. (Airesearch Mfg. Co. of Arizona Div.), Sky Harbor Airport, 402 South 36th St., Phoenix, Ariz. Gas turbine compressors model GTC 85-24, NOas 56-846-f(PD-41-1040-56), 509, $9,303,171.

Modern Metal Crafts Co., N.E. Corner York and American Sts., Philadelphia 33, Pa., Aero 2a explosive bolt pylons and explosive bolts, NOas 56-852-c (AR-45-4135-56), 1,200, $135,641.

General Development Corp., Elkton, Md. Construct, test and furnish experimental dacron envelope for NS2G-1 airship, NOas 56-860-f(AC-71-3704-56), 1, $325,622.

Beloek Instrument Corp., College Point N. Y. Bombing data computer, CP66A/ASB-1 NOas 56-923-f(AR-7-4236-56), 30, $3,839,362.

Boeing Airplane Co., Seattle 14, Wash., completion of 50-hr. flight rating test,

Navy Contracts

Following is a list of unclassified contracts of $25,000 and over as released by Navy Contracting Offices:

AVIATION SUPPLY OFFICE, 700 Robbins Ave., Philadelphia 11, Pa.

General Textile Mills, Inc., 450 Seventh Ave., N. Y. 1, N. Y., helmets, (383/29045-6203/5/57), various, $171,329.

Columbus Div., North American Aviation, Inc., 4300 E. Fifth Ave., Columbus 16, Ohio, ground handling equipment for AJ acft., (383/2110-1769/52), various, $330,816.

Eclipse-Pioneer Div., Bendix Aviation Corp., Teterboro, N. J., instruments, (383/2120-515x6/3/52, 383/2110-2132/52, 383/9504-52/56), various, $606,684.

McDonnell Aircraft Corp., P. O. Box 516, St. Louis 3, Mo., ground handling equipment for F2H aircraft, (383/2110-191883/3/51, 383/29065-75, S3/1/57), various $213,025.

Holley Carburetor Co., 11955 E. Nine Mile Road, Van Dyke, Mich., maintenance parts, (383/2118-134/53), various, $286,677.

Red Bank Div., Bendix Aviation Corp., Eatontown, N. J., generators and relays, (383/2140-402/54), various, $504,284.

B. F. Goodrich Tire & Equipment Co., A Division of the B. F. Goodrich Co., 500 South Main St., Akron 18, Ohio, deicer boots, (383/2110-993/53), various, $940,633.

Bendix Products Div., Bendix Aviation Corp., 401 Bendix Dr., South Bend 20, Ind., bellows, nozzle, valve assys, (383/2117-180/52), various, $171,145.

Northeastern Engineering Inc., S. Bedford St., Manchester, N. H., frequency meters, (IFB-383-2244-56), various, $335,486.

Scintilla Div., Bendix Aviation Corp., Sherman Ave., Sidney, N. Y., distributors, coils, magneto assys, (383/2117-120/52, 383/2116-201/53), various, $197,015.

Seymour Wallas & Co., 1200 S. 8th St., St. Louis 4, Mo., anti-blackout suits (IFB-383-461-57), $606,211.

Aeroquip Corp., 300 S. East Ave., Jackson, Mich., fitting ends (IFB 383-819-57), $44,752.

Pioneer Central Div., Bendix Aviation Corp., Davenport, Iowa, maintenance parts for regulator assys., (383/2150-5081X2/1/55 Aero), $39,852.

McDonnell Aircraft Corp., P. O. Box 516, St. Louis 3, Mo., windshield assys., (383/2110-1340/53), $269,004.

Gould-National Batteries, Inc., 35 Nevada St., Depew, N. Y., batteries (383/2140-1433-E 6/1/53), 4,577 ea., $233,218.

McDonnell Aircraft Corp., P. O. Box 516, St. Louis 3, Mo., elevator & flap assys., (383/2110-1242/53, 383/2110-2026/52, 383/2110-1240/53), various, $193,898.

Wm. R. Whittaker Co., Ltd., 915 N. Citrus Ave., Los Angeles 38, Calif., solenoids, body assys., (383/2118-225/53), various, $51,374.

Columbus Division, North American Aviation, Inc., Columbus 16, Ohio, pilot seats, (383/2110-1050/53) various, $31,055.

Eclipse-Pioneer Div., Bendix Aviation Corp., Teterboro, N. J., indicators, (383/2110-2128/52, 383/2120-695 x 6/3/52, 383/2120-789/52), various **$1,740,427.**

Kollsman Instr. Corp., 80-08 45th Ave.,

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Prepare and furnish twenty (20) copies of a model specification for the Yt60-BO-2 (Boeing model 520-2) engine. Design fabrication parts and test as required to demonstrate satisfactory XT60-Bo-2 engines, NOas 56-1053-c (PP-23-2153-56), $354,443.

Boeing Airplane Co., Seattle, Wash., Boeing model 502,11B gas turbine driven air compressor completely self-contained on a four-wheel towable cart trailer, NOas 56-1069-c (MA-45-5212-56), 20, $564,724.

Nordem-Ketay Corp., Milford, Conn., bombing data computer, CP66A/ASB-1NOas 56-924-f(AR-74236-56), 18, $2,971,170.

Irving Air Chute Co., Inc., 1315 Versailles Rd., Lexington, Ky., automatic parachute opening devices, NOas 57-316-f(MA-30-3778-57), $335,089.

Lockheed Acft. Service, Inc., P. O. Box 33, Ontario, Calif., services and materials for progressive maintenance of R7V-1 acft, NOas 57-276-c (MA-44-4379-57), $1,677,031.

Stanford Research Institute, Menlo Park, Calif., study of changing structural design of combat aircraft, NOas 57-101-c (IP-31-4861-57), Job, $202,990.

Temco Aircraft Corp., P. O. Box 6191, Dallas 2, Texas, acquisition, rehabilitation & installation of machine tools and equipment, NOas 57-041-c (IP-31-4956-57), $587,537.

Goodyear Aircraft Corp., Akron 15, Ohio, services and materials necessary to furnish general airship indoctrination and systems maintenance training courses, NOas 57-315-f, (IFB-MA-303823-57), $106,847.

Bell Aircraft Corp., Fort Worth, Texas, helicopters, Model HTL-7, spare parts, and special support equipment, NOas 57-188, $1,996,918.

Stewart-Warner Corp., (Stewart-Warner Elec. Div.) 1300 N. Kostner Ave., Chicago 51, Ill., sixty (60) man-months of field engineering services, altering, repairing or operating and giving assistance in instructions on aircraft electrical & electronic equipment NOa 57-249-s (IFB MA35-3746-57), $72,330.

Electrol Inc., Kingston, N. Y., materials and service necessary to replace government-owned machine tools NOas 57-029-c (IFB 31-4913-57), $200,000.

McDonnell Aircraft Corp., P. O. Box 516, St. Louis 3, Mo., preparation of facilities for shipment NOas 57-004-c, (IFB IP-12-4875-57), $30,000.

Librascope, Inc., 808 Western Ave., Glendale 1, Calif., modification of CP-209 (XN-2) (ASB computer NOas 57-414-c) (IFB AV-32-3568-57), $140,736.

Bendix Aviation Corp., Eclipse-Pioneer Div., Teterboro, N. J., preparation of facilities for shipment, NOas 57-019-c (IFB-IP-3-4899-57), $33,500.

RCA Service Co., Inc., Camden, N. J., field engineering services in the maintenance, repair and operation of aircraft electrical and electronic equipment, NOas 57-236-s, (IFB MA-30-3758-57), $1,031,849.

NAVY DEPT., BUREAU OF ORDNANCE, Washington, D. C.

Hycon Mfg. Co., Pasadena, Calif., guided missile test sets, Prop No. NOrd-132-56, NOrd-17400, $404,400.

Columbia Research and Development Corp. Columbus Ohio, Improve the safety and reliability of the 30 mm aircraft gun MK 4/30 mm feed mechanism MK 2/30 mm ammunition link MK 1 weapon system, NOrd-17127, $132,926.

Hughes Tool Co. Aircraft Div. Culver City, Calif. improve safety and reliability of the 30 mm aircraft gun and MK 4/0 ammunition link Mk 1 weapon system, NOrd-17128, $166,740.

Bulova Research and development laboratories, Woodside, N. Y. Research and development in connection with guided missile fuzes NOrd-17030, $312,370.

DISTRICT PUBLIC WORKS OFFICES, Sixth Naval District Building 13, U. S. Naval Base, Charleston, S. C.

T. B. Bourne & Associates and Reynolds, Smith & Hills, P. O. Box 4817, Jacksonville, Fla., architectural-engineering services for site feasibility study for the proposed Naval Air Station, Sixth Naval District NBy-10228, $97,300.

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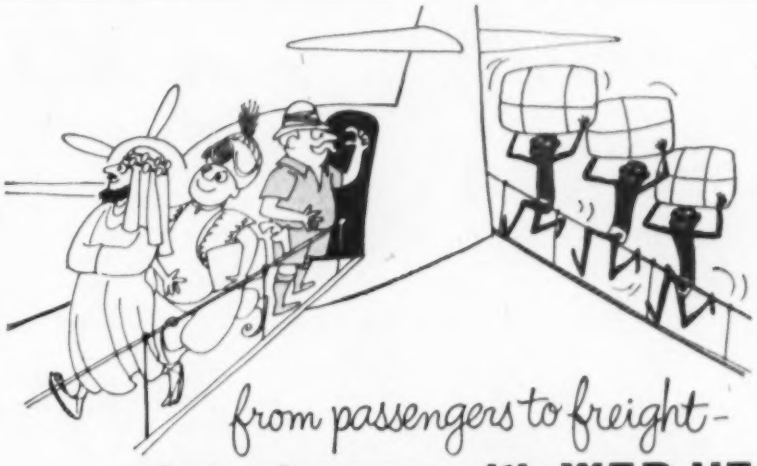

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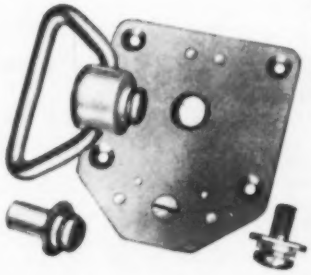

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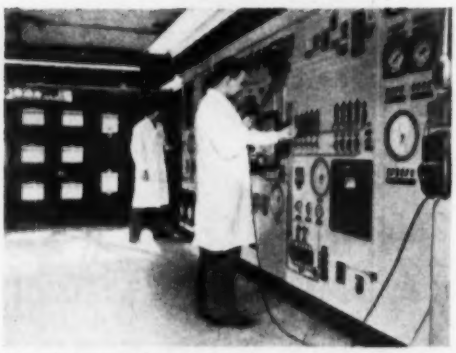

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son, 115 Park St., HAAS Bldg., Jacksonville, Fla., architectural-engineering services for the preparation of plans and specifications for interim facilities, Naval Air Station, Sanford, Fla., NBy-10222, $66,920.

Nat G. Harrison, Jr., and Associates, 5137 N. E. 2nd Ave., Miami, Fla.; utilities and structures at Walker Cay, Carter Cay and San Salvadore Island, B.W.I. for the AF Missile Test Center, Offshore facilities. (NBy-6474), job, $434,000.

DISTRICT PUBLIC WORKS OFFICE, Eleventh Naval District, San Diego 22, Calif.

R. E. Ziebarth and S. B. Alper, 21205 Bolsa Street, Torrance, Cal, Procurement and installation of electrical generating equipment at San Nicolas Island, Naval Air Missile Test Center, Point Mugo, Cal, Contract NBy-5469 (IFB 5469/56B) job, $249,890.

U. S. NAVY PURCHASING OFFICE, 1206 S. Santee St., Los Angeles 15, Calif., Jan. 21, 1957.

Hunter Douglas Aluminum Corp., 3016 Kansas Ave., Riverside Calif., necessary labor and material to manufacture 5".00 target rocket. N123(60530)11862A (Sch 73770-12-14-56), job, $70,622.

Atlantic Research Corp., 812 N. Fairfax St., Alexandria, Va., personnel, facilities, techniques and materials to design, manufacture and deliver fifty end burning grains and twenty incremental grain assys. of arcite propellant. N123(60530) 11843A (Sch 72624-10-24-56) job, $60,000.

PHILADELPHIA ORDNANCE DIST., 128 N. Broad St., Philadelphia 2, Pa.

Western Electric Co., Burlington, N. C., Nike spare parts & components, $129,353; $31,718; $1,360,800; $38,880; $45,004; $48,160; $1,175,760.

Western Elec. Co., Inc., Burlington, N. C., Nike spare parts & Components, $134,680.

Kennedy-Van Saun Mfg. & Eng. Corp., Danville, Pa., shell for cartridge, 81MM, HE, M-362, 428,400 ea., $846,800.

U. S. NAVAL TRAINING DEVICE CENTER, Port Washington, N. Y.

Melpar, Inc., Falls Church, Va., Design development and construction of H-37A Helicopter Operational Flight Simulator Trainer, Contract N61339-31 lot $1,983,981.

NAVY PURCHASING OFFICE, 4th & Independence Ave. Sw. Washington, D. C.

Airesearch Mfg. Co. of Arizona, 402 S. 36th St. Phoenix, Ariz. Air turbine starters model A-20 and QAD Disconnect and related parts. (N600(A)42411)(IFB600) 1646-56) 542 ea, $340,080.

Bendix Aviation Corp. 211 Seward Ave, Utica N. Y. Air turbine starter model A-14 and QAD disconnect and related parts (N600(A)42419) (IFB600-1644-56) 211 ea, $223,663.

Airesearch Mfg. Co, of Arizona 402 S. 36th St, Phoenix, Ariz, Air turbine starter Model A-21 and QAD disconnect and related parts (N60(A)42405) (IFB600-1654-56) 930 ea, $544,960.

Jack and Heintz, Inc, 17600 Broadway, Cleveland, Ohio starter model E-3, (N600(A) 12629) (IFB 600-1770-56) 489 ea., $229,341.

NAVY DEPT., Bureau of Ships, Washington 25, D. C.

Boeing Airplane Co., 7755 E. Marginal Way, Seattle, Wash., conduct research required to evolve new designs for components for a 400 HP continuous rating gas turbine engine, Contract NOas-72211 (Inv. No. 550-31Q), $251,461.

Solar Aircraft Co., 2200 Pacific Highway, San Diego, Calif., gas turbine air supply units with special tools, Contract NOas-73134 (Inv. No. 550/526-36Q), 28 ea., $327,293.

DISTRICT PUBLIC WORKS OFFICE, Eighth Naval District, New Orleans, La.

E. E. Farrow Co., P. O. Box 13186, Dallas 20, Texas. Steam Jet Ejectors, Barometric Condensers and Related Facilities, Naval Ordnance Aerophysics Laboratory, Daingerfield, Texas, (IFBNBy-1136) $863,473.

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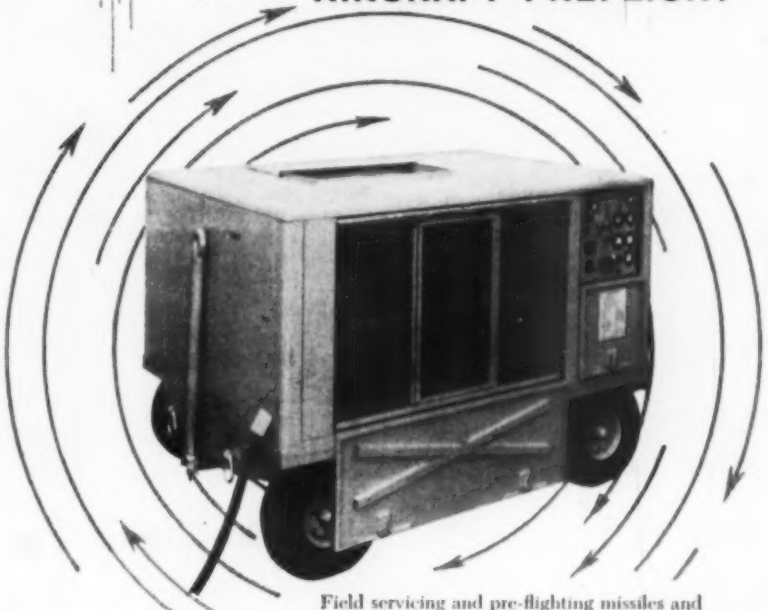

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CAB Accident Investigation Report:

United C-54 Flies Off Course, Hits Peak

United Air Lines Flight 409, a Douglas C-54B-DC, N 30062, struck Medicine Bow Peak, Wyoming, near its top at approximately 0726,[1] October 6, 1955. All of the occupants were killed and the aircraft was demolished.

HISTORY

Flight 409 originated at New York, New York, on October 5, 1955, destination San Francisco, California, with intermediate stops including Chicago, Illinois; Denver, Colorado, and Salt Lake City, Utah. The trip to Denver was routine except for traffic delays, caused principally by weather, and the flight arrived there at 0551, October 6, one hour and 11 minutes late. Routine crew changes were made at Chicago and Denver, the last crew consisting of Captain Clinton C. Cooke, Jr., First Officer Ralph D. Salisbury, Jr., and Stewardess Patricia D. Shuttleworth. No discrepancies were reported by the former crew and none were found at Denver. While at Denver the aircraft was refueled to a total of 1,000 gallons of gasoline.

Prior to departure Captain Cooke was briefed by the company's dispatcher on the en route weather, based on both U. S. Weather Bureau sequence reports and forecasts and the company meteorologist's forecasts and analysis. Following this briefing the flight was dispatched to Salt Lake City via airways V-4, V-118, V-6, and V-32, to cruise at 10,000 feet, and to fly in accordance with Visual Flight Rules (VFR). The estimated time en route was two hours and 33 minutes. The only obligatory reporting point along the route was Rock Springs, Wyoming.

The flight departed Denver at 0633, with 63 passengers, including two infants. At takeoff, the gross weight of the aircraft was 64,147 pounds, 653 pounds under the allowable weight of 64,800 pounds; an error of 100 pounds in excess of the allowable rear baggage compartment weight[2] was made in loading. Flight 409 reported its time off to the company and this was the last known radio contact with the flight.

When the flight failed to report at Rock Springs at 0811, its estimated reporting time, repeated efforts were made to establish radio contact with it. These were unsuccessful and the company then declared an emergency. A widespread search was immediately coordinated by Air Search and Rescue, which included the Wyoming Air National Guard, the Civil Air Patrol, and United Air Lines. At approximately 1140 the same day, the wreckage was sighted near Medicine Bow Peak, 33 miles west of Laramie, Wyoming. The Laramie weather at 0728 was: Scattered clouds, 5,500 feet; visibility 40 miles; wind west-northwest 13 knots; snow showers of unknown intensity over the mountains.

INVESTIGATION

The aircraft struck the almost vertical rock cliff of the east slope of Medicine Bow Peak (elevation 12,005 feet) located in the Medicine Bow Mountains. The crash occurred at an elevation of 11,570 feet, 60 feet below the top of that portion of the mountain directly above it. Two large smudge marks were apparent on the face of the mountain. In these marks were four scars, evenly spaced and in a horizontal line, the result of the engines and propellers of the aircraft striking the cliff.

At impact the aircraft disintegrated and the wreckage was strewn over a wide area. Some parts were thrown to the mountain top above the crash site, others rested on ledges at various levels, and the remainder fell to the slope below.

In order to be closer to the scene so that the recovery operation and investigation could be conducted expeditiously, a base camp was established on the mountainside at an elevation of 10,400 feet. Above the camp, travel was extremely difficult up a talus slope to the base of the cliff. From there it was necessary to scale the almost vertical cliff a distance of 600 feet to reach the point of impact. Because of the rugged terrain, groups of experienced mountain climbers were formed in an effort to reach locations otherwise inaccessible. Removal of the bodies of the victims took several days because of the rugged terrain and snow conditions. While this was being accomplished investigation was considerably hampered by falling rocks dislodged by the climbers.

Dangerous Site

As the investigation continued the Board decided that working conditions were too dangerous for other than the experienced mountain climbers and, therefore, investigators who had at this time reached an elevation of 11,275 feet were not allowed to proceed further. At this elevation several large sections of the aircraft were found, including the empennage which had been broken from the fuselage just in front of the vertical fin.

Sufficient portions of the aircraft were identified to indicate that it was intact at the time of impact. This was substantiated by the fact that no portion of wreckage was found during an extensive air and ground search of the determined flight path. The empennage and portions of the fuselage and wings were studied.

The entire empennage section was severed aft of the passenger cabin near station 929. This section was generally intact and was wedged in an opening in the cliff. The left stabilizer and elevator were severely damaged but the right stabilizer and elevator received only minor damage. The fuselage forward of the empennage, including the cockpit, disintegrated at the time of impact. Only twisted and distorted portions of each were located. Examination of the control cables indicated tension type failures. The left windshield, with windshield wiper attached, was found, its frame twisted, and the glass shattered.

Parts Examination

No evidence was found in the examination of the recovered parts of the aircraft or its components to indicate that fire or structural failure had occurred prior to impact.

The four engines were located and examined. They were badly damaged but no evidence was found to indicate they were not functioning in a normal manner prior to impact.

All 12 propeller blades were accounted for; these were badly twisted and bent. Examination of the propeller blades and propeller hubs indicated that all four propellers were rotating at the time of impact.

Both large CO_2 bottles and one hand bottle were found. These were empty and their valves had been broken at impact.

Oxygen bottles were also recovered with valves attached. Laboratory tests showed that these bottles did not contain oxygen when examined and that there was no toxic contamination. A pilot's smoke mask was recovered but it was impossible to determine if it had been worn during the subject flight. The pilots' oxygen masks were not recovered.

Two cabin heaters were found. These were so damaged that an operational test could not be made. However, teardown inspection revealed nothing to indicate malfunctioning prior to impact.

Three watches and an aircraft clock were found and examination showed that the average time of their stoppage was 0726.

The radio and navigational equipment on board the aircraft was damaged in a manner which did not permit reliable readings to be made. All ground navigational facilities that could have been involved were checked as soon as possible after the accident and were found to be operating within tolerances.

A study of the maintenance records showed that this aircraft had been properly maintained in accordance with company procedures and Civil Air Regulations.

On October 6, 1955, at the time of the subject flight, a large high-pressure area was centered over Idaho. This high-pressure area was preceded by a cold front which, at the time of the accident, was located

[1] All times herein are mountain standard and based on the 24-hour clock; all altitudes are mean sea level; and all miles are nautical.

[2] This minor error, affecting the center of gravity of the aircraft, had no bearing on the accident.

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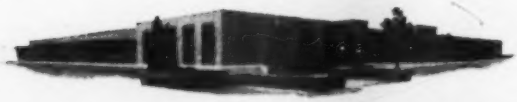

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500 to 600 miles to the southeast. This resulted in the weather being generally fair with some scattered clouds over the lower terrain of the planned route Denver to Salt Lake City.

However, off the airway broken to overcast cloud conditions, accompanied by light snow showers, were present over the high mountain peaks and ridges. From the available information it is concluded that the free air wind at the 12,000-foot level in the Laramie, Wyoming,-Medicine Bow Mountain range was from 330 degrees at 30 to 40 knots. The velocity of the wind in the immediate vicinity of Medicine Bow Peak can only be estimated; however, it is believed that because of added terrain effect it could have been increased to 50 to 60 knots.

This would have resulted in downdrafts and turbulence being present near the lee slope and probably for a distance of 10 to 15 miles away from the mountain on that side.

Considerable thought and study were given to the possible existence of a mountain wave[a] condition in that area. Some of the factors associated with the formation of a mountain wave were present; however, a number of the factors considered vitally important were not present and it is doubtful if such a wave did exist at the time of the accident.

A pilot flying a small aircraft on October 6 from Cheyenne, Wyoming, to Reno, Nevada, passed Medicine Bow Peak approximately 22 miles to the east and north within a few minutes of the time the accident occurred. He described the weather conditions as follows: ". . . the haze was thick especially to the north.

"However, the visibility toward the mountains was very good. The tops of the mountains were hidden by white cumulus clouds whose tops I estimated to be about 13,000 feet. I was especially interested in the tops at the time as I had considered, before leaving Cheyenne, using the Victor 4[b] airway but was warned by the lady in the Weather Bureau that I could expect heavy turbulence and strong downdrafts over the mountain."

Witnesses

During the investigation a number of persons believed to have seen the aircraft prior to its striking the cliff were interviewed. None of these witnesses could positively identify the aircraft they saw as a United Air Lines C-54; however, they said the airplane was large and had four engines. All of the witnesses who were in the general vicinity of Medicine Bow Peak agreed that this airplane was silver in color and was flying in a northwesterly direction toward the peak.

Three witnesses, who were at a logging camp located about 10 air miles southeast from the crash site, said that the airplane did not appear to be turning but that its right wing was slightly down. They estimated its altitude to be about 10,000 feet by the known elevation of the camp (9,600 feet), the approximate height of the nearby trees (60-75 feet), and that the aircraft did not appear to be higher than 500 to 600 ft.

These witnesses saw the airplane (for only a short time) several hundred yards away and through a clearing in the trees. The aircraft was then flying immediately below the clouds and intermittently flew either into or behind clouds, momentarily obstructing their view of it.

Noise Like Cannon

One of these witnesses said he believed one propeller was not rotating; others said they believed all of the engines were operating in a normal manner. One witness testified that a few minutes after the airplane passed from his view he heard a noise in the distance which sounded like a cannon firing or a mining blast. He did not at that time associate the noise heard with the airplane he had seen.

In the vicinity of the camp at the time were low rolling clouds and the visibility was somewhat hazy owing to dusting snow; the sun could not be seen. Medicine Bow Peak could not be seen from the camp because of terrain obstructions. A check was made of all available sources, both civil and military, to determine if another airplane of that size could have been flying in that vicinity at that approximate time; none was found.

As a result of information obtained from the witnesses, a probable flight path was constructed. This flight path, projected from the accident site on a magnetic heading of 120 degrees, covered a distance of approximately 23 miles. An extension of this flight path to the southeast crosses the planned route in the vicinity of Ft. Collins, Colorado, and to the northwest again crosses it near Rawlins, Wyoming.

Medicine Bow Peak is located abbout 124 miles north-northwest of Stapleton Field, Denver, and is 33 miles west of Laramie. A few miles south of the peak the mountains can be crossed at an altitude of 10,000 feet and once beyond them the North Platte River valley can be followed to the vicinity of Rawlins (Sinclair radio.)

As previously stated, the company Flight Plan and Dispatch Release for the subject flight specified a course to be flown VFR over airways V-4 Denver to Laramie, V-118 to Rock River radio, V-6 to Fort Bridger, Wyoming, and V-32 to Salt Lake City; weather analysis, weather forecasts, and sequence reports were attached. This document was signed by both the dispatcher on duty and Captain Cooke.

The "Weather Analysis" portion of the release was signed by Captain Cooke as having been prepared by him. Under the subsection entitled "Mass Weather" was the following: "High-pressure area, Great Basin moving slowly eastward, scattered, occasionally broken and cumulus clouds along the east slope of the Rockies based above flight level. Air slightly rough."

A review of all documents pertaining to

[a]Under certain atmospheric conditions, a strong windflow perpendicular to a mountain ridge will produce a wave-type structure on the lee side similar to the waves produced downstream from fast-flowing water over a submerged rock. These waves develop on a tremendous scale, often two or more times the height of the mountain barrier which produced them. Violent downdrafts, updrafts, and turbulence occur in the wave when it is well developed. When moisture content of the air involved is favorable, characteristic cloud patterns develop in the wave.

[b]Victor 4 Airway lies just north of Medicine Bow Peak and extends between Laramie radio and Cherokee radio on a magnetic bearing of 273 degrees.

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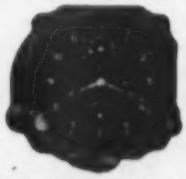

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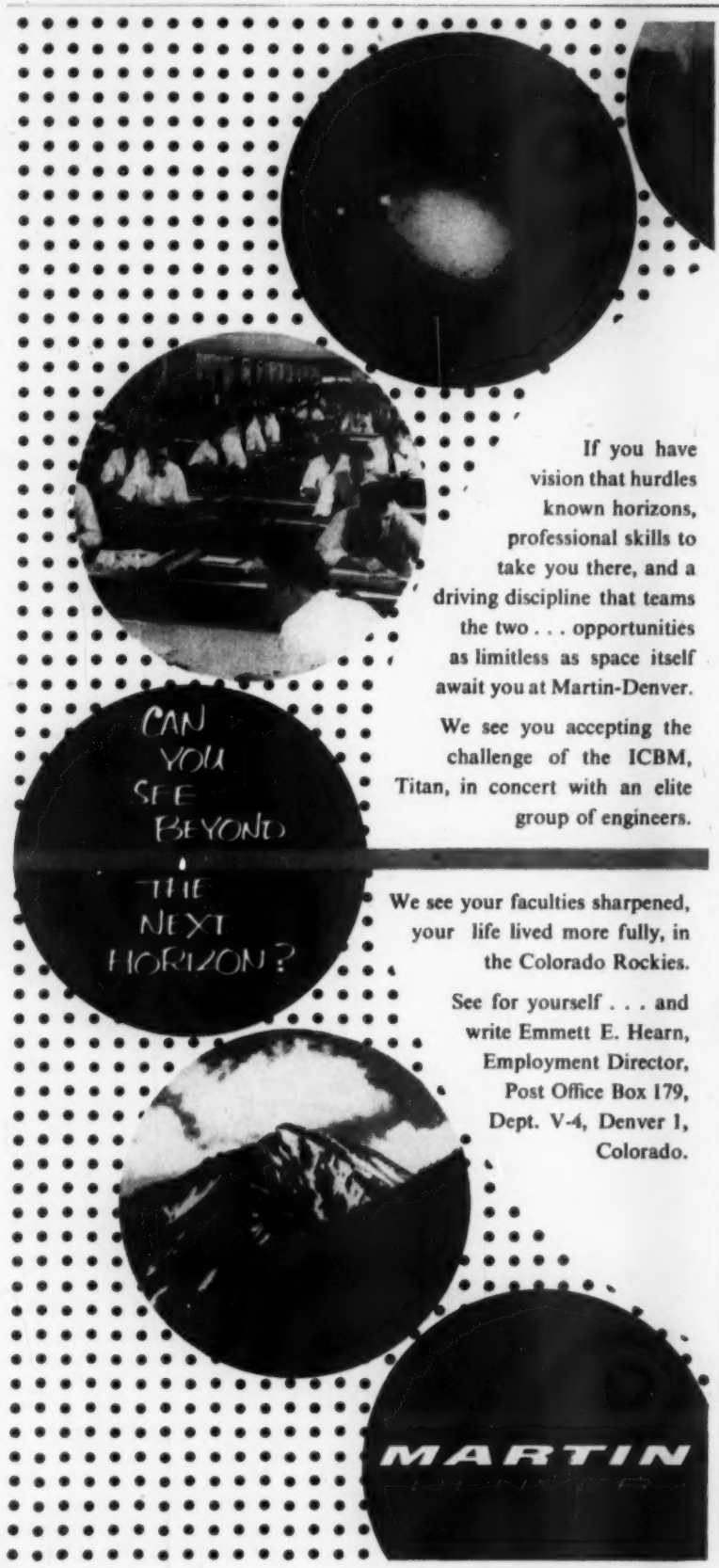
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the dispatch and release of the aircraft at Denver, together with the testimony of company personnel, indicates that other than the error in loading the rear baggage compartment the dispatch was made in accordance with United Air Lines' established procedure. Company officials testified that under VFR conditions any deviation from the prescribed route, either in altitude or direction, is the captain's responsibility but must be coordinated between the captain and dispatcher. Captain Cooke did not advise the dispatcher of any intended deviation from the flight plan.

The Company Flight Operations Manual re - Maximum Levels - Unpressurized Cabins - states: "Flight will normally be conducted at levels not to exceed 12,000 feet above sea level . . . ." Another company rule is: "In VFR conditions, flights will check and follow the radio navigational courses which define the airway . . . ." These and other company rules governing VFR-IFR flight represent a company policy which is patterned for the safety and comfort of its passengers.

Captain Cooke was qualified to fly the route involved in August, 1951, and had flown it 45 times in the year preceding the accident. According to his superiors in the company he had never been known to deviate from a planned route without advising the dispatcher.

In accordance with the Board's policy of keeping accident investigations open for consideration of new evidence, and since incapacitation of the crew was a possibility that could neither be supported nor negated by existing evidence, it was decided to return to the accident scene to continue the investigation. This could not be done for an appreciable time because of deep snow on the mountain. However, prior to the decision to continue the investigation, the wreckage had been released to the carrier and, because it was believed to be a hazard to the public welfare, an attempt was made to destroy and bury it—this was done by U. S. military ground and air forces.

Second Investigation

On August 27, 1956, a second investigation was begun. This working group, headed by Board personnel, included employes of United Air Lines and company pilots representing the Air Line Pilots Association. The investigation on the mountain took three days, and many aircraft parts which had previously been examined were re-examined. Numerous components of the cockpit, together with the fuselage nose section, were found at an elevation of 11,390 feet on a rocky ledge. This wreckage was badly damaged by impact, and the ensuing fire.

Beneath a portion of the wreckage the cockpit combustion heater was found. It was mashed flat and was bent 90 degrees near its middle. The igniter plug, with its lead torn away, remained in place. All fuel and air controls were missing. The heater was brought back to Washington, D. C., subsequent to the investigation and was delivered to the National Bureau of Standards for further examination. It was the Bureau's determination that all failures were apparently caused by mechanical damage.

It is possible that the mechanical damage referred to could have occurred on impact. The No. 3 propeller hub found on the

talus slope was further examined. Its dome shell was broken off and the piston was broken. The distributor valve was mashed in the end of the propeller shaft. All but three of the barrel bolts were broken and the barrel halves had separated approximately one inch. The barrel bolts were removed and the barrel halves separated in order to examine the dome position. The stop rings were in place and had been in position for a blade range of 24 degrees low pitch and 93 degrees full feathering. The dome piston position indicated a blade angle of approximately 31 degrees.

Because of the extensive impact damage to the propeller it was impossible to remove the rear barrel half from the propeller shaft. Parts of two spider shim plates and two brass shims were recovered. By matching the pieces of the shim plates, an impact mark was determined which indicated an approximate blade angle of 38 degrees. Impact marks on the brass shims indicated approximate blade angles of 35 degrees.

A propeller governor was also located on the talus slope. It was determined from the model and serial numbers of this governor that it had been installed on the No. 4 engine. The drive shaft coupling was missing and the drive shaft housing was pushed inward at impact. The control pulley was broken from the head; the control shaft was intact. The control head was removed and installed on a serviceable governor.

This assembly was then placed on a governor test stand in order to check the rpm. setting of the control head. This test revealed that the control head was positioned for 2,080 engine rpm, which is within the normal cruising range for the subject aircraft and engine. Disassembly of the control head revealed a slight binding of the shaft due to impact. The counterbalance spring was intact with normal tension. Examination of the pilot valve and flyweight assemblies revealed no indications of operational distress. All this additional evidence concerning the propellers and their related systems substantiates the fact that all propellers were rotating at the time of impact.

ANALYSIS

Hazardous working conditions throughout the investigation of this accident made it difficult to examine adequately pertinent components of the aircraft; however, there are many known factors and the careful consideration of these is presented.

It is obvious from the established flight path that the aircraft deviated from the planned route a number of miles to the west, of course. Although witnesses close to the scene of the accident were unable to positively identify the aircraft they saw, in the light of known facts it is reasonable to assume that the aircraft seen was the United C-54. Therefore, it can be concluded that, considering the weather conditions and mountainous terrain, the aircraft was flying at a dangerously low altitude at that time.

A UAL captain testified that it was normal procedure for UAL pilots, during a climbout from Denver under VFR conditions, to fly several miles east of the airway. He said this was done to avoid incoming low-flying aircraft which usually begin their letdown near Fort Collins, Colorado. This

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fact was considered in computing probable flight data for Flight 409, from which it was determined that the flight reached its cruising altitude of 10,000 feet approximately 25 miles north of Denver. From this point a heading of approximately 315 degrees magnetic would have been required to fly to Laramie. From this same location a magnetic heading of 300 degrees would have been necessary to fly directly toward Medicine Bow Peak.

An extension in both directions of the known flight path indicates that either a shortcut was being attempted when the accident occurred or that the crew was incapacitated and the aircraft was flying without assistance.

In considering the first premise, it is difficult to understand how a pilot of Captain Cooke's experience would deliberately attempt a shortcut, and even if he did why he would have flown at such a low altitude over hazardous terrain. It is true that the flight was an hour and 11 minutes late; however, the time saved by taking a shortcut would have been inconsequential. Prior to departing Denver the crew had full knowledge, through weather reports, that scud and turbulence were present in the mountainous areas and that snow squalls were expected to occur.

Knowing this, and the fact that the weather along the planned route was good, makes a shortcut even more incomprehensible; also, Captain Cooke was fully aware of the hazards accompanying mountain flying. There is also the fact that the visibility was 40 miles that morning and it is evident that the clouds covering the mountains could have been seen from a considerable distance.

To cross the mountains over Medicine Bow Peak safely, an altitude of approximately 14,000 feet would be necessary. Such an altitude and its attendant passenger discomfort in a nonpressurized aircraft would normally be avoided. Finally, to deviate from course in this manner, the captain would have been breaking rigid company rules and his record indicated that he had never been known to do so.

Crew Incapacitation

Considering the navigation equipment on board the aircraft, the fact that all pertinent ground facilities were functioning in a normal manner, the pilot's knowledge of the terrain, and the good visibility prevailing that day, it does not seem possible that a navigational error of any magnitude could have been made.

The matter of crew incapacitation cannot be completely ruled out. The cockpit heater, when examined, did not indicate any burnouts prior to impact which could cause poisonous gasses to enter the cockpit; however, the exhaust manifold was badly damaged and some of it was not recovered. Should this portion of the heater have been defective, dangerous gasses could have entered the nosewheel well and could have been transported from there to the cockpit by means of the ground blower. However, the ground blower is normally turned off before the aircraft becomes airborne and is never turned on in the air unless there is a blockage of the nose ram airscoop. Although the incapacitation of persons in the cockpit in this manner appears unlikely, it nevertheless cannot be completely discounted. Also, it is possible that the crew

may have become incapacitated by some other means. One possible fact points strongly toward this not being true—when the aircraft was only four minutes from Medicine Bow Peak it was flying at an altitude of approximately 10,000 feet.

Since the aircraft struck the moutain at an altitude of 11,570 feet it must have climbed about 1,500 feet in approximately four minutes, and it appears likely that some positive action on the part of the crew was necessary to accomplish the climb.

In consideration of the above facts, the Board is of the opinion that there is insufficient evidence to establish that the deviation from the planned route was due to incapacitation of the crew, errors in navigation, or malfunctioning of the aircraft or any of its components, but rather that the pilot deviated from the planned course for reasons unknown.

FINDINGS

On the basis of all available evidence the Board finds that:

1. The carrier, the aircraft, and the crew were properly certificated.
2. The gross takeoff weight was within the allowable limits at the time of takeoff; improper distribution of the load was of such minor extent it was not a factor.
3. The flight plan was properly prepared by the crew.
4. The weather along the prescribed route was good and the aircraft could have been flown safely at an altitude of 10,000 feet.
5. The pilot deviated from the planned route.
6. The aircraft was observed flying in and out of clouds at an approximate altitude of 10,000 feet, 10 miles southeast of the accident scene and 21 miles west of the prescribed course.
7. The aircraft struck the mountain peak at an altitude of 11,570 feet.
8. Examination of the recovered sections of the aircraft failed to indicate any fire, structural failure, or malfunctioning of the aircraft or its components prior to impact.

PROBABLE CAUSE

The Board determines that the probable cause of this accident was the action of the pilot in deviating from the planned route for reasons unknown.

By The Civil Aeronautics Board:

James R. Durfee
Chan Gurney
Harmar D. Denny
G. Joseph Minetti

SUPPLEMENTAL DATA

The Civil Aeronautics Board was notified of this accident at 1000, October 6, 1955. An investigation was immediately initiated in accordance with the provisions of Section 702 (a) (2) of the Civil Aeronautics Act of 1938, as amended. A public hearing was ordered by the Board and was held in Denver, Colorado, on November 14 and 15, 1955. This hearing was reconvened January 9, 1957, in Washington, D. C.

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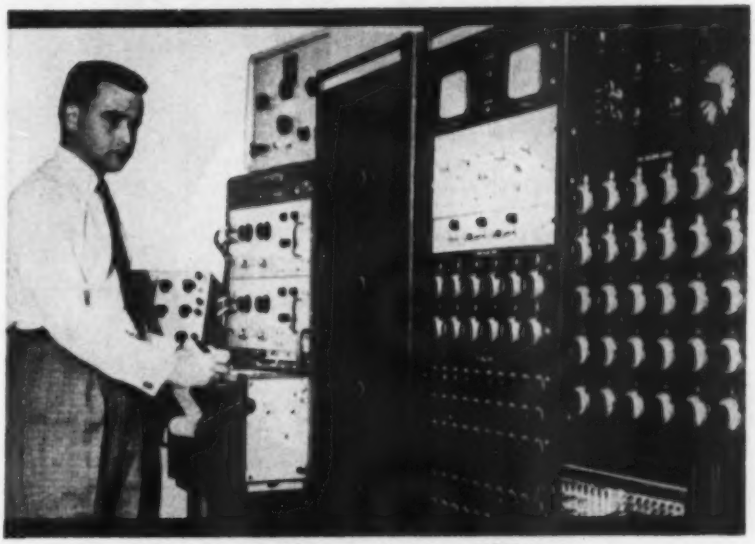

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Captain Clinton C. Cooke, Jr., age 35, held a currently effective airman certificate with airline transport rating and an appropriate rating for the subject aircraft. Captain Cooke was employed by United Air Lines on January 13, 1944. He had a total of 9,807 pilot hours, of which 2,289 hours were in the type equipment involved. His last physical examination was on June 22, 1955, and his last route check was on June 20, 1955.

First Officer Ralph D. Salisbury, Jr., age 33, held a currently effective airman certificate with commercial rating. He was employed by United Air Lines on May 21, 1952. He had a total of 2,418 pilot hours, of which 343 hours were in the type of equipment involved. His last physical examination was on August 23, 1955, and his last route check was on November 12, 1953.

Stewardess Patricia D. Shuttleworth, age 21, was employed by the company in February 1955. She graduated from the Stewardess School in Cheyenne on March 7, 1955, and was assigned to Salt Lake City April 13, 1955. Her performance and evaluation records as a stewardess reflect excellent grades.

N 30062, a Douglas C-54B-DC, manufacturer's serial number 18389, was manufactured in 1943 and had a total time of 28,755 hours with 1,289 hours since the last overhaul. It was currently certificated by the Civil Aeronautics Administration. The aircraft was equipped with Pratt and Whitney model R2000-11 engines and Hamilton Standard model 23E50 propellers with model 6507 blades. Time since major overhaul on the four engines was within approved limits.

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Merchant Navy and Air Line Officers Assn., which represents the engineers, opposes performance of more than one function by the same officer of an aircraft. British Air Line Pilots Assn. believes engineer duties are too few aboard the Britannia for the engineer to make a significant contribution to the work load.

New working party was set up to clarify the situation, with recourse to the National Joint Council.

WHO'S WHERE

(*Continued from page 23*)

Changes

Frank R. Carver, head-radar development department, and **E. E. Herman,** head-radar systems department, Airborne Systems Laboratories, Hughes Aircraft Co., Culver City, Calif. Also: **John C. Bailey,** head-scientific and general recruitment, Systems Development Laboratories.

James O. Gregory, a transport pilot for the Los Angeles Division, North American Aviation, Inc., Los Angeles, Calif.

H. Fisk Tarbox, manager-newly created Aviation Sales Department, Mobil Overseas Oil Co., affiliate of Socony Mobile Oil Co.

Alfred Schaff, Jr., manager-test and field service, Aerojet-General Corp.'s Solid Rocket Plant, Sacramento, Calif.

Lorne W. Frame, public relations manager, Crenda Engines, Limited, Malton, Ontario, Canada.

Gen. Roger M. Ramey (USAF, ret.), a consultant with Radioplane Co., subsidiary of Northrop Aircraft, Inc., Van Nuys, Calif.

H. Richard Alexander, western regional customer relations manager, (Manhattan Beach, Calif.), Stratos, division of Fairchild Engine & Airplane Corp., Bay Shore, N. Y.

Clare E. Barkalow, associate manager-advanced engineering division, Lear, Inc., Grand Rapids, Mich.

Frank J. Beach, director-airfreight traffic, American Airlines, Inc. Also: **John W. Colthar,** director-schedule development; **Alfred E. Deshell,** manager-passenger tariffs; **Arthur M. Morton,** manager-schedules; **Mark Forrester,** manager-airfreight tariffs.

Oliver Judd, station ground services manager (Portland, Ore.), United Air Lines, Inc. Mr. Judd succeeds **E. S. Maroney,** deceased.

Frank F. Davis, domestic sales manager, California Division, Lockheed Aircraft Corp., Burbank, Calif.

G. Norris Shaw, senior military liaison engineer, Temco Aircraft Corp., Dallas, Tex.

Robert M. Hawley, director-sales and customer relations, Weapon Systems Division, Bell Aircraft Corp., Buffalo, N. Y.

William F. Callejo, manager-properties, Slick Airways, Inc. Also: **James M. Mask,** director-purchasing.

Howe H. Hopkins, chief engineer, Air-cooled Motors, Inc., Syracuse, N. Y.

Dr. Donald M. Allison, Jr., assistant manager-military products, Radio Division, Bendix Aviation Corp., Baltimore, Md.

J. W. Stack, director-sales and contracts (Milwaukee plants), AC Spark Plug Division, General Motors Corp., Flint, Mich.

W. J. Rutherford, aviation sales manager, General Logistics, Pasadena, Calif.

William G. Alexander, chief engineer, Stromberg-Carlson, a Division of General Dynamics Corp., San Diego, Calif.

R. W. Powell, assistant division manager, Avionics Division, Aerojet-General Corp., Azusa, Calif. **B. J. Gastineau** succeeds Mr. Powell as chief engineer.

George E. Beringer, general manager-aircraft products section, Bendix Products Division, Bendix Aviation Corp., South Bend, Ind. Also: **Richey W. Whitesell,** administrative assistant to the general manager.

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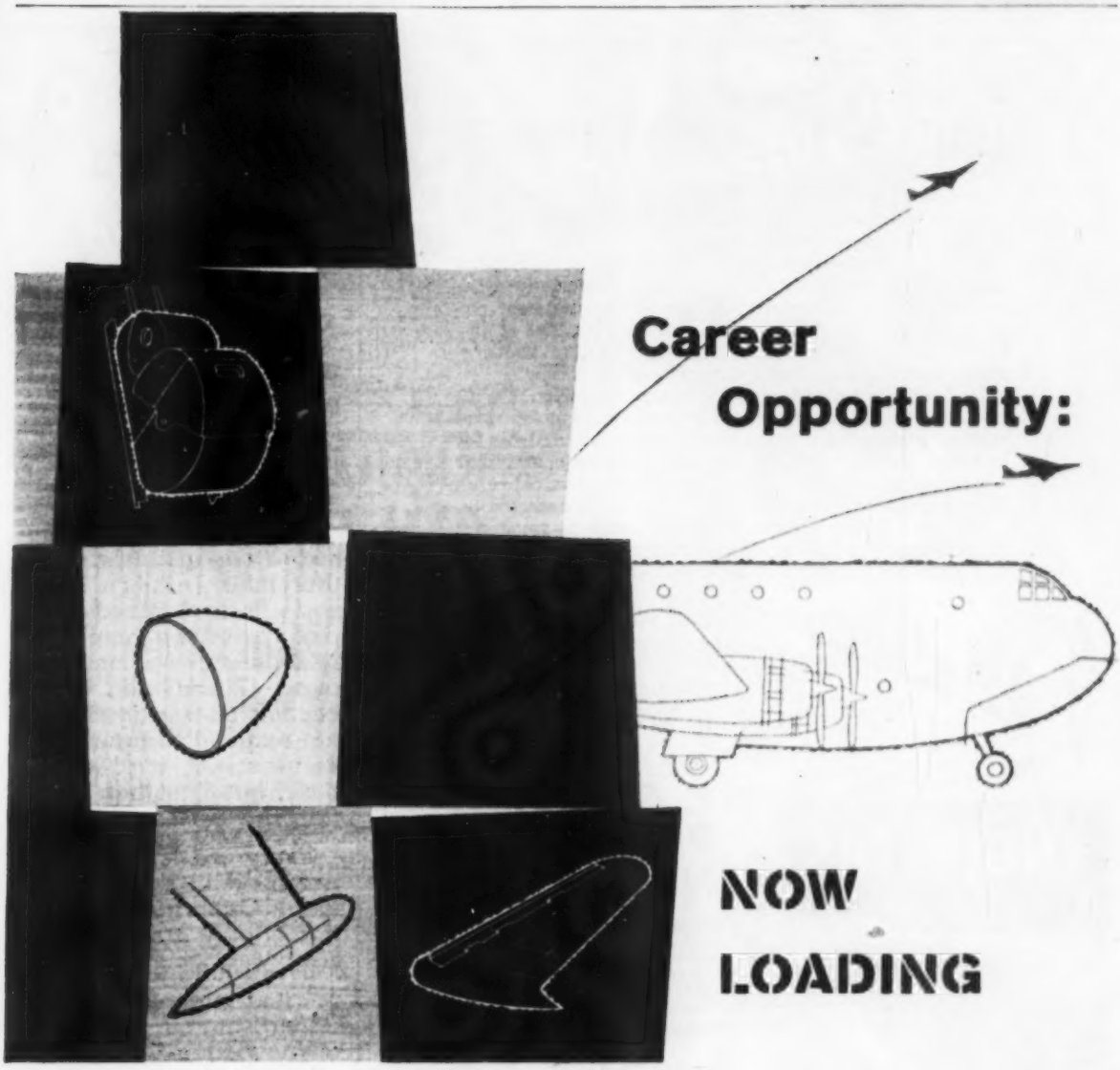

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We want a man willing to do a job and be rewarded accordingly. For further details, write or phone Director of Industrial Relations in strict confidence.

John Oster MANUFACTURING CO.
avionic division
RACINE, WISCONSIN

ENGINEERS — DESIGN MECHANICAL

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AC provides financial assistance toward your Master's Degree. Graduate Program also available evenings University of Wisconsin, Milwaukee.

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Milwaukee offers ideal family living in a progressive neighborly community in Southern Wisconsin.

For personal confidential interview in your locale send full facts about self to

Mr. Cecil E. Sundeen,
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THE ELECTRONICS DIVISION
GENERAL MOTORS CORP.
Milwaukee 2, Wis.

To EMPLOYERS who advertise for MEN:

When there are many applicants for a single position it frequently happens that the only letters acknowledged are those of the most promising candidates. Others may not receive any indication that their letters have even been received by a prospective employer much less given consideration. These men often become discouraged, will not respond to future advertisements, and sometimes question their bona fide character.

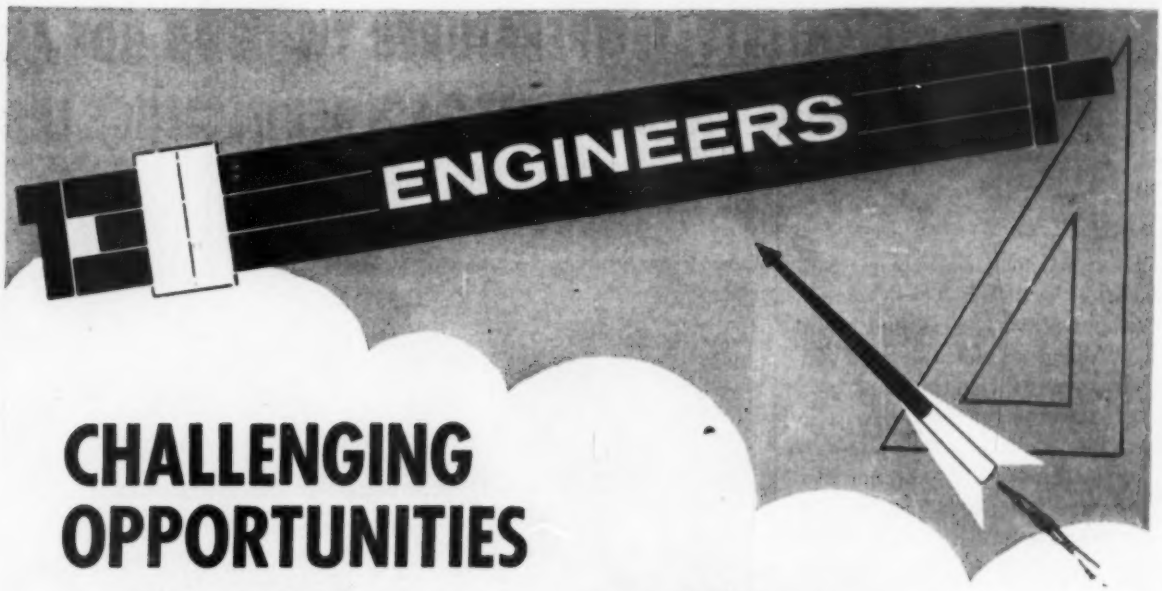
Every advertisement printed in the Employment Opportunities Section is duly authorized.

It will help to keep our readers interested in this advertising if you will acknowledge every application received, even if you merely return the letters of unsuccessful applicants with "Position filled, thank you" written or stamped on them.

We suggest this in a spirit of cooperation between employers and the men replying to Employment Opportunity advertisements.

Classified Advertising Division

McGraw-Hill Publishing Co., Inc.



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The men hired will enjoy working with some of the top men in the field and with the finest test, research and development facilities. GM's long-standing policy of decentralization creates individual opportunity and recognition.

Why not send us full facts about your education, work background, etc. We will do all we can to treat your application with the fullest confidence.

AC SPARK PLUG THE ELECTRONICS DIVISION
GENERAL MOTORS CORPORATION
MILWAUKEE 2, WIS. FLINT 2, MICH.

ENGINEERS-SCIENTISTS: TEMPERATURES TWICE AS HOT AS SUN'S SURFACE NOW PRODUCED AT G.E.'S AEROSCIENCE LAB

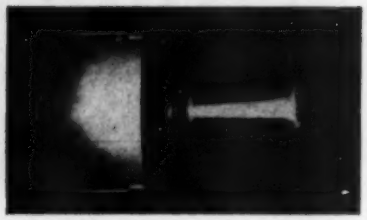
New "Water Arc" Advances Nose Cone Technology at Missile & Ordnance Systems Department of General Electric

When MOSD became prime contractor for ICBM Nose Cone development, engineers and scientists here were faced with the necessity of creating not only new systems concepts, new components, new materials and new fabrication techniques, but also the *very tools and facilities to evaluate them.*

Meteors may melt on entering the earth's atmosphere, but the relatively thin-skinned nose cone must come through in full functional order. To test out heat-resistant materials capable of withstanding re-entry temperatures, a new instrument was devised under the direction of the research staff of MOSD.

STABILIZED WATER ARC and G-E designed TUNNEL shown during operation. Material undergoing test is held in front of the arc orifice by means of a rod or "string" running through the tunnel.

3000 KW used in operating this stabilized arc and evacuation tunnel. (Shown idle.) Has ¾" nozzle diameter. Present plans call for construction of a 3" diameter model, requiring 80,000 KW for operation.



View of fluid-stabilized arc in operation. The liquid revolving inside the glass or plastic cylinder flowing at high velocity offers insulation as well as the material of which the plastic beam is composed.

...the WATER-STABILIZED ARC

How does the new water arc differ from the conventional electric arc? It is controlled–or stabilized–by a whirling blanket of water, which produces a "squeezing" effect, forcing the arc into the shape of a column. By causing a great amount of electrical current to flow across the column, extreme temperatures may be maintained continuously, subject only to the limitations of available power.

Valuable experiments are now being conducted at MOSD's Aeroscience Laboratory with the stabilized water arc. The most advanced heat-resistant materials are subjected to temperatures as high as 25,660°F–more than twice the heat of the sun's surface.

OTHER WAYS OF CREATING HYPERSONIC ENVIRONMENT AT MOSD

G.E. has built the largest, most powerful Shock Tunnel in the country in Philadelphia. Here free flight conditions in the order of Mach 20 can be matched. MOSD also utilizes a high power Centrifuge to test behavior of electromechanical and structural components under gravity loads up to 100G's.

OPENINGS FOR MEN WHO CAN EXPLORE NEW TECHNICAL AREAS

Engineers and scientists find an ideal research environment at MOSD. They work in small groups on problems of prime scientific interest – in close contact with managers and top specialists.

Located in downtown Philadelphia, adjacent to University of Pennsylvania and Drexel Institute, it is easy to take advantage of G.E.'s Tuition Refund Plan for graduate study.

EXCEPTIONAL GROWTH OPPORTUNITIES:

Organized only in '56, MOSD has been growing phenomenally, and continued expansion is scheduled for '57. This expansion creates many opportunities to rise to positions of higher responsibility and income level. All of the managers of technical groups are themselves engineers or scientists and the majority have come up from within this or other departments of General Electric.

YOUR INQUIRIES INVITED:

If you are a Graduate Engineer or Scientist and have experience in these or related fields:

MATERIALS AND PROCESSES • AERODYNAMICS • AEROPHYSICS • THERMODYNAMICS • ELECTRICAL DESIGN • ELECTRONIC OR ELECTROMECHANICAL COMPONENT DESIGN • STRUCTURAL DESIGN • STRESS ANALYSIS • DATA PROCESSING • SYSTEMS • SYSTEMS TEST • FIELD TEST • VIBRATION • INSTRUMENTATION • CONTROLS • GROUND SUPPORT EQUIPMENT DESIGN • TECHNICAL WRITING • ARMING AND FUZING • INERTIAL GUIDANCE

...send us your resume or, if you prefer, write us for a convenient application form.

Your resume will be carefully reviewed by the MANAGERS of our various technical components. If qualified, you will be invited to visit our offices and discuss the work we are doing directly with the managers with whom you would be working. All communications will be entirely confidential.

Mr. John Watt, Professional Placement, Room 590-1

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It's one thing to talk about "variety" in career opportunities. But it's quite another matter to actually have a variety of positions to offer—and to be able to prove it.

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and **HMEE HAS IT** *within these areas; offering assignments in the design and development of:*

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What's more, **HMEE HAS IT** *in such additional assignments as:*

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There is a wide range of mechanical engineering openings. The packaging of our systems for ground-based, marine, or airborne environments imposes intriguing problems in serviceability, accessibility, mobility, and durability. These positions require basic theoretical knowledge of machine design, stress analysis, shock and vibration, gearing, and heat transfer.

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And remember, variety is only one advantage we have to offer. Along with this growth opportunity, there's the proven, long-range stability to be found here (after all, we're a part of General Electric!)... the educational opportunities of our 100% Tuition Refund Plan for advanced study at Syracuse University... and many family benefits as well.

So, if it's variety you want—and all the other advantages to be found at HMEE, do something about it! Take a few moments to write us about your education, experience, and most important, your *interests*. We'll respond promptly.

Write in complete confidence to: Mr. George B. Callender, Dept. 62P

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GENERAL ELECTRIC

Court Street, Syracuse, New York

ENGINEERS and PHYSICISTS for RESEARCH and DEVELOPMENT

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Development of electronic-inertial systems and components for applications to measurement, data processing, and guidance of aircraft missiles. Problems include: gyroscopic and inertial instrumentation, magnetic devices, telemetering, data processing, electro-mechanical instrumentation and launching mechanisms.

AERODYNAMICS, AEROELASTICITY, AND MECHANICS

Theoretical, model and full scale investigation of non-steady aerodynamics and aeroelastic response of aircraft and missiles. Problems include: lift growth, transient drag, shock wave diffraction, supersonic and hypersonic flow, and advanced hydrodynamics. Also: thermoelasticity, vibration analysis, control and testing.

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Theoretical and experimental research in such diverse fields as extremely high temperature plasmas; the hydrodynamics of extreme shocks; instrumentation for nuclear physics; radiation transport and aerophysics.

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- A salary limited only by your ability.
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Opening for Co-Pilot-Mechanic. Chicago-Based DC-3 D18S A&e Comm. Instrum. ratings preferred. P-4756, Aviation Week.

Flight engineers experienced on Constellation 1049 Aircraft. Consideration also given to engineers experienced on earlier model Constellations. Address replies to Chief Flight Engineer, California Eastern Aviation, Inc. Oakland International Airport, Oakland, California.

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Mechanic-Co-Pilot position wanted. Ten years all types maintenance and repair experience. Commercial and instrument ratings. PW-4937, Aviation Week.

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Engineer. 10 years aircraft experience; hard-ware, equipment and design. Desire position in Southwest or Florida. PW-4878, Aviation Week.

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Classified Advertising Division—

AVIATION WEEK

P. O. BOX 12 **New York 36, N. Y.**

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Qualifications: B.S. in Engineering.

Location: TWA's ultra modern building now nearing completion at Kansas City, Mo.

Living Conditions: Excellent, both city or suburban private homes or apartments.

Benefits: Many employee benefits, including liberal free transportation for yourself and family each year.

Salary: Commensurate with experience.

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Mr. R. Paul Day, Employment Manager

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LETTERS

Towing Winch

It has taken me this long to come down out of the clouds about the very fine treatment you gave Claude Witze's excellent story on the H-21 towing demonstration (AW, March 25, p. 64-65). Everybody here was just as pleased as they could be with the picture layout and the text treatment you gave us. Our sincere thanks and gratitude to all of you.

There is only one sad note in connection with this story, and that is undoubtedly our fault. The story says that the electric winch that was used for the towing was Vertol-designed. Charlie Wendt, president of All American Engineering, has called my attention to the fact that this was actually an AAE Model 80 winch. And because AAE's winch was a key factor in the success of the towing project, I want to set the record straight with you.

Edward J. Doherty
Assistant to the President
Vertol Aircraft Corp.
Morton, Pa.

Amplification

I should like to congratulate you on the technical accuracy of the article on the Bell Aircraft Corporation Automatic Carrier Landing System that appeared in the March 4 issue (p. 32-33) of Aviation Week.

One point, however, should be further amplified.

The Bendix P-1 autopilot mentioned in your article was used in the early flight test phase of the system. Later tests were conducted with a Douglas F3D using the Minneapolis-Honeywell MH-19 autopilot. We have also landed successfully a North American F-86 using a Lear F-5 autopilot, a Cessna 310 with a Lear L-2 autopilot, a Convair 340 with a Sperry A-12 autopilot and a F-94C using a Westinghouse W3A autopilot.

I should also like to thank you for mentioning the names of project personnel in your article. Bell Aircraft Corporation, as a matter of policy, feels that corporate successes should reflect credit upon the individuals responsible for them.

Robert C. Sellers
Safes Mgr., Avionics Div.
Bell Aircraft Corp.
Buffalo, N. Y.

F-105 Vs. F-107

There is a news item about the F-105 and F-107 competition in the March 11 issue (p. 25) of Aviation Week which says the F-105 holds a speed advantage and the F-107 has more range and payload. I believe this is an error in numbers. The F-107 is reported to be the faster of the two airplanes and the F-105 has the favorable margin on range and payload.

The competition between the F-105 and the F-107 is more interesting if a comparison is made between their predecessors, the F-84 and the F-86. In the Korean War most of the aerial combat was done by three good airplanes—the MiG-15 lightweight fighter, the F-84 fighter bomber, and the F-86 fighter. The short range MiG-15 had a high rate of climb and was very maneuverable, especially at high altitude. The F-84 was no match for the Mig-15 in aerial combat and the MiG-15 was a poor fighter bomber with its short range and small payload.

The F-86 was both a fighter and a fighter bomber. As a fighter its kill ratio of about 15 to 1 over the MiG-15 may never be equaled or exceeded. The F-86's record as a fighter bomber is also impressive. It held the world's speed record for several years which gave it the ability to make an unescorted speed run to the target, drop its bombs, and fight its way out against the attacking MiG-15's. The dual mission capability of the F-86 could not be equaled by the MiG-15, the F-84, or any fighter in the world at that time. This designed-in versatility made the F-86 Sabre jet the world's greatest deterrent to more "little wars" like the Korean War.

Today in the near Mach 2 speed range there is an identical situation of three great airplanes.

They are the Russian MiG-21 lightweight fighter, the F-105 fighter bomber, and the F-107 fighter. All three are good airplanes but the F-107 is the only one that can do the job of the other two fighter airplanes.

The Red Air Force will gain air superiority both in quality and quantity unless we build more fighters to combat their MiG-21 lightweight fighter. Even a streamlined atomic army with mobile missile launchers can not defend itself against superior airpower. The USAF has two fighters that could combat the MiG-21. They are the F-104 lightweight fighter and the F-107 fighter. The F-104 is the only one in production. Unofficial reports about the F-107 indicate that it is heavier, has a longer range, can lift a bigger payload, and costs more than the F-104. This was exactly the basic difference between the F-86 Sabre jet and the MiG-15 before the Korean War. The Korean War brought out the other differences that made the F-86 the most economical deterrent to the "little wars."

LeRoy F. Iverson
3524 Elm Ave.
Manhattan Beach, Calif.

Misunderstanding

In the interest of accuracy, both in statements and instruments, I'm taking this means of correcting some apparent misunderstandings as expressed in the letter of your correspondents, Messrs. Hobley and Baylis of the Canadian Aviation Electronics Limited, which you published in the March 4 issue of Aviation Week (p. 142) in answer to a letter of mine which appeared in the Nov. 26, 1956 issue (p. 122).

In studying the description of the Kollsman Integrated Flight Instrument System as it appeared in the March 5, 1956 issue of Aviation Week, Messrs. Hobley and Baylis seem to have received the erroneous impression that the altitude information provided by the system was true altitude rather than pressure altitude. Furthermore, they apparently overlooked the statement in my letter in which I stated, ". . . this is a commercial development and the system was designed primarily for, and in conjunction with, the scheduled airlines. . . ." Naturally, an instrument designed for this use would not be designed to measure true altitude since all commercial flying at least, is based on pressure altitudes.

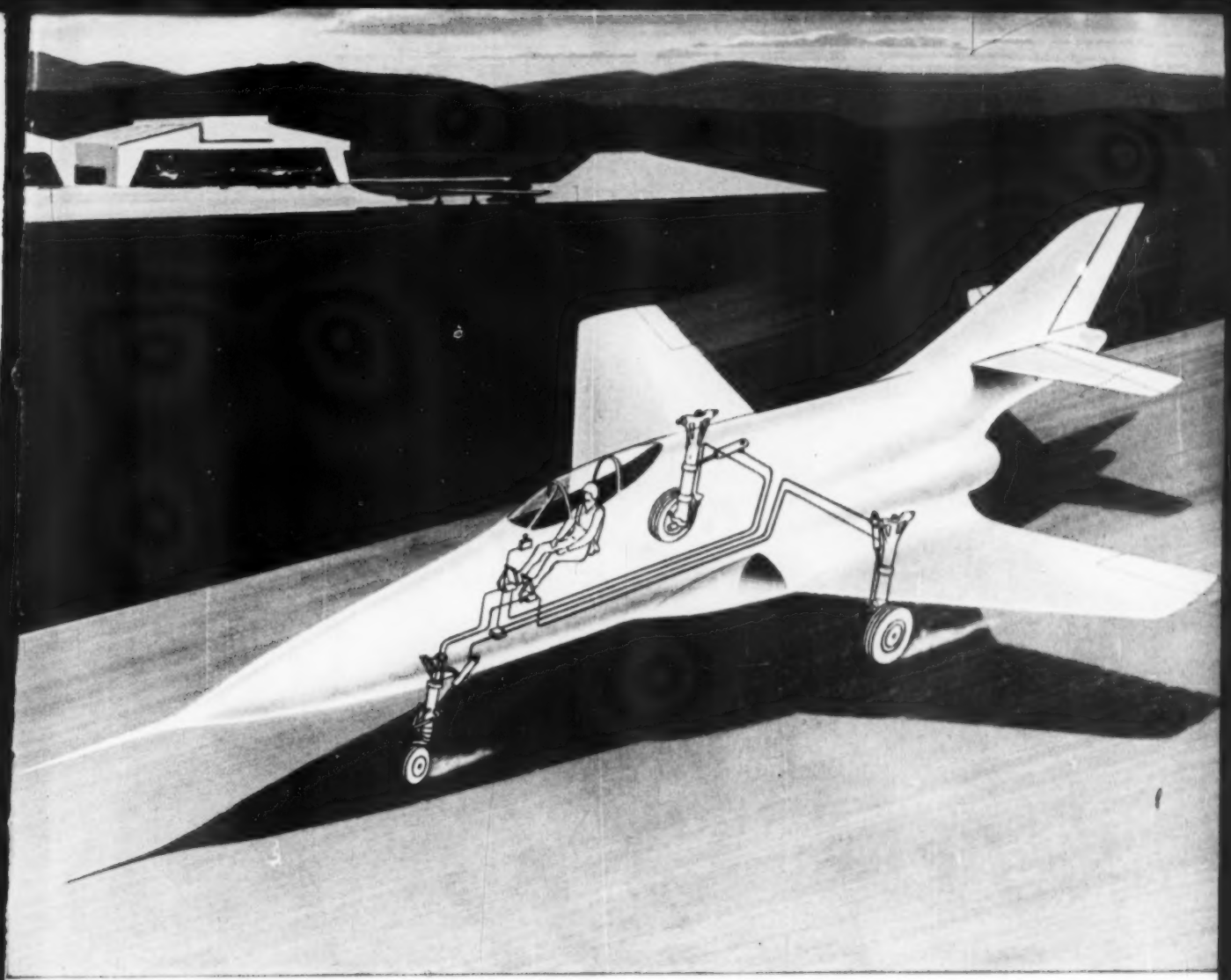
In trying to arrive at what they thought might be the true accuracy of the equipment in question, they claim to have statistically added various factors which contribute to altimeter errors associated with conventional instruments. In so doing, they arrived at a combined possible error of 230 ft. at an altitude of 40,000 ft. Although the factors mentioned as contributing to altimeter errors may be correct for conventional (uncorrected) instruments, a feature of the Integrated Flight Instrument System—the scale error corrector—has been entirely overlooked. This component is designed to correct for the calibration error which, from a practical standpoint, leaves only the error introduced by hysteresis and the setting error. The diaphragm hysteresis factor loses its importance, because in airline operation the effect is almost negligible. The setting error is beyond the system to control. However, the factors affecting this are being attacked on several fronts.

In my earlier letter I made the claim that altitude information provided by the system would be accurate to within plus or minus 100 ft. at 40,000 ft. This figure included tolerances for both the static system and the instrument scale error correctors. However, since the static corrections are based on the assumption that the error (expressed in feet) is a function of angle of attack and Mach number, rather than the classical assumption which also includes altitude, and since in practice tolerances are established by making use of Mach number vs. altitude performance envelopes for particular aircraft to minimize the differences between the two assumptions, a tolerance of plus or minus 120 ft. may be experienced at 40,000 ft.

As for the statement concerning the variation in altimeter readings experienced by the eight F-80's at 36,000 ft., I'm sure Messrs. Hobley and Baylis have overlooked some of the reports on static system errors in military aircraft. Errors of plus or minus 1,200 ft. at 20,000 ft. have been accepted in production type aircraft and, in some cases, errors of 5,000 ft. at operating altitudes.

Everett H. Schroeder
Kollsman Instrument Corp.
Elmhurst, N. Y.

Aviation Week welcomes the opinion of its readers on the issues raised in the magazine's editorial columns. Address letters to the Editor, Aviation Week, 330 W. 42 St., New York 36, N. Y. Try to keep letters under 500 words and give a genuine identification. We will not print anonymous letters, but names of writers will be withheld on request.



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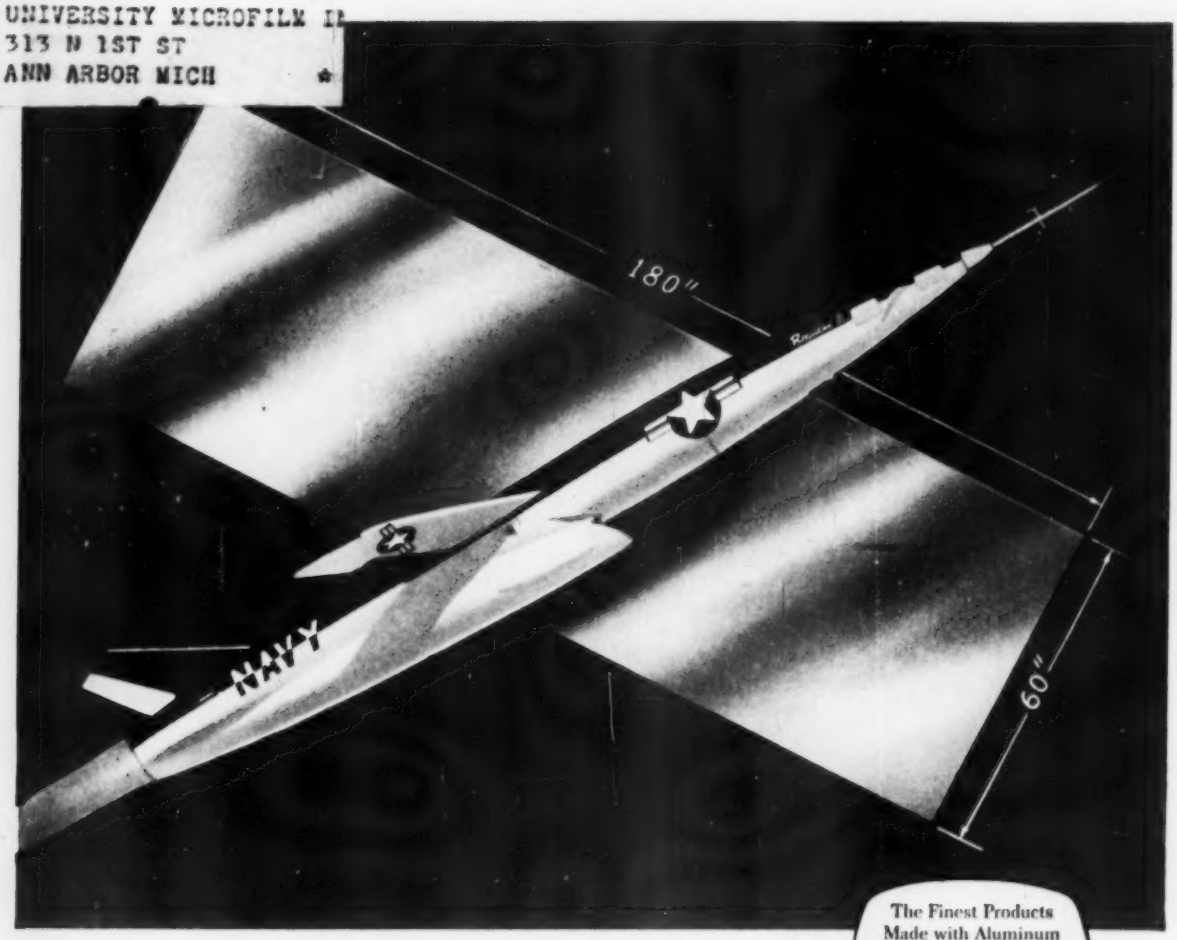

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